User Interface Design Practice for Web sites and Web-Based Applications in New Zealand

A thesis presented in partial fulfillment of the
requirements for the degree of

Masters
in Information Systems
at Massey University, Albany campus, New Zealand

Ramesh Lal

Monday, August 16, 2004

DECLARATION

This is to certify that the research carried out for the Masters thesis entitled "User Interface Design Practices for Web sites and Web-based Applications in New Zealand" was done by Ramesh Lal in the Information Systems, Massey University, (Albany), New Zealand. The thesis material has not been used in part or in whole for any other qualification, and I confirm that the candidate has pursued the course of study in accordance with the requirements of the Massey University regulations.

Supervisor's Name
SCOTT P. OVERMYER

Signature

Date
14-07-04

Candidates Name
RAMESH LAL

Signature

Date
14-07-04.

Abstract

The research regarding user interface design practices for Web sites and Web-based applications revealed that there is very little awareness in the industry in New Zealand of usability issues. There is general lack of education, knowledge, and skills in usability methods, processes, and techniques amongst designers and developers. Generally speaking universities in New Zealand have not kept up with global changes in human – computer interaction (HCI) education. Most universities in New Zealand offer one or two HCI courses within their information technology undergraduate degree programmes, and those are not compulsory for students to study. Conversely, HCI has become a major area of study in universities from Australia, US, and the UK where usability is a major industrial concern. One possible reason for this is that New Zealand universities do not offer cognitive psychology and social science courses with information technology major to make HCI courses more relevant for students who study HCI.

Table of Content

Chapter 1 1

1.1 Introduction 1

1.2 Research questions 7

1.3 Background 9

1.4 Outline of the study 15

Chapter 2 17

2.1 Literature review 17

2.2. Conclusion 106

Chapter 3 108

3.1 Methodology 108

Chapter 4 114

4.1 Results of the Survey done in industry 114

4.2 Results of the Survey done with six major universities 127

4.3 HCI courses in overseas universities 133

Chapter 5 146

5.1 Discussion of results of the survey done in the industry 146

5. 2 Discussion of results of the Survey done with six universities 189

5.3 Discussions of HCI courses with overseas universities 200

Chapter 6 205

6.1 Conclusion 205

6.2 Recommendations 207

References 209

Chapter 1

1.1 Introduction

The use of the Internet in scientific and research communities in New Zealand has grown swiftly from just a few users in the early 1990s to hundreds of thousands by 2004. Most of the growth of New Zealand Internet during this period has been the result of an increasing number of businesses providing information about their products and services via the Web on informational sites, and at the same time some going on-line to do business by electronic commerce (e-commerce).

Statistics provided by Statistics New Zealand in 2002 reveal that the number of New Zealanders with Internet access at any location has grown from 16 percent in 1996 to nearly 70 percent in 2001. These figures show that New Zealanders have adopted the Internet rapidly. They also show that there is a huge opportunity for businesses in New Zealand to use the Internet to make their services and products easily available to new customers outside their traditional marketplace.

The statistics on Information Technology provided by Statistics New Zealand in 1999 state that by March of the same year New Zealand had over 15,000 Web sites of which 13,000 were commercial Web sites. On the other hand Jakob Nielsen (2000), the guru of Web site design, had predicted that by 2003 there would be 200 million Web sites around the globe. This provides people who have access to the Internet with a vast range of alternatives and choices. So for New Zealand businesses, while the Internet provides a huge local and international marketplace, it also provides competition from many other business organizations that offer similar products and services.

According to Powell (2000) Web sites can be characterized in to various types such as: (a) commercial sites, (b) informational, (c) entertainment, (d) navigational, (e) community, (f) artistic, and (f) personal. Whilst the majority of Web sites in New Zealand are purely informational sites, there is a growing number of business Web sites that are engaging in e-commerce. One of the main reasons why many business organizations have Web sites is that it gives them a competitive advantage, while others go online to match competitors who already have a presence on the web. As a result, in New Zealand and elsewhere, many Web sites have appeared overnight, which are not only poorly designed, lacking required functionality, but completely ignore the usability requirements.

In today's competitive marketplace many business organizations believe that their Web site is the gateway to the information, products and services it provides to the public, but many of these Web sites do not meet the needs of the customers and users they are trying to serve. Many of these Web sites are technology driven, reflecting the current state-of-the-art technology and it appears that Web site design and development is based entirely on the organization's business functionalities with no consideration given to usability factors. In the opinion of the researcher, it appears that the majority of New Zealand Web sites have been designed and developed with very little or none at all of the necessary ground work such as a user study to base their design decisions on. There also appears to be no formal processes, techniques or methodologies involved which enable businesses to design and develop usable Web sites.

The www.webdirectory.natlib.govt.nz/index.htm that belongs to The National Library of New Zealand, www.nzs.com, and www.piperpat.co.nz/nz/index.html are three New Zealand Web sites that provide a compressive Web directory that lists all the New Zealand companies and organizations that have Web presences.

In the opinion of the researcher, it appears that the majority of small to medium business organizations in New Zealand had their Web sites designed and developed by Web development companies, and the majority still have the content of their site updated and maintained by them. It is also worthwhile to note that some of the small business organisations had their Web sites designed and developed by students as part of their projects.

A count of Web development companies in the last two years of The Net Guide publications, a New Zealand computer magazine that provides a list of Web development companies in New Zealand, reveals that presently there are about 80 such companies. Large business organisations, government departments and tertiary institutes in New Zealand now have their own Web development team, but the majority of them had their initial Web sites designed and developed by Web development companies.

It appears that most Web development companies in New Zealand are small, with no more than 2 to 3 staff members, and only a few will have more than five members as part of their design and development team. Also at present, it appears that the majority of Web development companies in New Zealand do not have a team member who has education, qualification or skills in usability or HCI.

In the last five years Web site owners and developers, in particular from America and from European countries, have recognized and addressed the issue of usability. Due to stiff competition, many companies that have gone online are now paying serious attention to the user interface design of their Web sites in order to make their Web sites more accessible and usable for their users and other Web surfers.

The tertiary education providers in America, Australia and in European countries have gone a long way to provide the necessary qualifications and training in the area of HCI so that industry has access to graduates that will enable them to design and develop usable and user friendly Information Technology products. The HCI (Human-Computer Interaction) Webliography (www.hcibib.org/education) that provides resources on HCI lists 61 universities worldwide, including 34 universities from America and 4 from Australia, that provide IT courses and offers sufficient papers to enable students to do a major in HCI for undergraduate degree programmes. These universities also have the required resources and facilities for students to pursue postgraduate study leading into masters and doctoral programmes in HCI.

The need to develop knowledge and train students in this field has led to some of these universities having a separate HCI department from the computer science and information systems departments. These universities also have a usability lab that plays a huge part in teaching HCI papers, and also in research and development in this area.

While none of the major New Zealand universities are listed by HCI Webliography (www.hcibib.org/education) as a provider of courses that would enable students to do a major in HCI, it lists HITLABNZ (Human Interface Technology Laboratory New Zealand) as a research lab in HCI, which is hosted at the University of Canterbury in Christchurch in partnership with the HITLABUS that is based at the University of Washington.

HCI Webliography (www.hcibib.org/education) has listed only two consultancy firms in usability or user interface design in New Zealand. The very low number of consultancy firms is another reason that suggests that New Zealand businesses are still not aware of the importance of dealing with usability issues in business Web sites. The United States of America and European countries have seen the emergence of many consultancy companies in the user interface design area that produce effective and usable user interfaces for Web sites and Web-based applications, and also for other application software. HCI Webliography lists 295 usability consultancy companies worldwide which include: (a) 12 in Australia, (b) 125 in USA, and (c) 21 in UK. It also list usability consultancy companies from other European countries such as from Switzerland, Belgium, Sweden, Spain, Norway, Netherlands, Greece, Germany, Finland, France, Ireland, Denmark and from the rest of world such as Canada, India, Israel, Singapore, and South Africa.

The Nielsen Norman Group (www.nngroup.com/events), which is a US consultancy company led by Dr. Jacob Nielsen, who is one of the most influential usability professionals, has been regularly presenting seminars and tutorials in Australia that deal with usability issues of Web sites. These seminars and tutorials have created increased awareness in Australia about the importance of creating usable user interfaces of Web sites. It appears that these kinds of seminars and tutorials for academics, developers and owners of Web sites have never happened in New Zealand.

The Engineering Group (www.uie.com), a usability consultancy company headed by Jarred Spool, has been regularly running conferences and tutorials on the usability of Web sites in the US and UK. Based on their research and experiences, Spool's group has been teaching Web developers new techniques, processes and methods to create usable Web sites. New Zealand also lags behind in these kinds of usability conferences and tutorials.

In New Zealand the traditional business sectors such as banking, airline travel, education, retail and groceries are increasing their presence on the Web, and some are going online to do business by adopting e-commerce. Various New Zealand local and central government departments now have an online presence that provides information and services to both local and international users. It is very important that these Web sites are easy to learn and use since usability is a prerequisite for survival on the Web.

New Zealand Web site owners have to quickly realise that Internet users, both locally and worldwide, are becoming more sophisticated and are demanding more personalized service to cater for their individual needs. On the other hand, the online marketplace, both locally and internationally, is full of choices and alternatives, and any failure to meet an individual customer's needs will likely mean a quick switch to a competitor.

A browse through the IT courses in the calendars of the six major universities in New Zealand reveals that even though all the major universities offer HCI papers, for majority of these universities these papers are not compulsory in computer science or information system degrees. It is becoming clear that New Zealand universities are falling behind in providing courses in HCI compared to universities from the US, Australia and European countries. While it is not known at this point of time if universities in New Zealand are aware of this, it is very important that universities in New Zealand thoroughly equip their IT graduates with knowledge and skills in HCI, and in particular usability, so that we start to see Web sites, Web-based applications and other application software developed with an easy-to-use interface and a human element in it.

It is also important to create awareness in New Zealand among academics, who are responsible for designing and delivering Web and Web-related courses, of the current practices and guidelines for user interface design, and in particular the usability issues. These academics will play an important role in emphasizing the importance of user interface design through the classroom.

We were unable to identify any previous research that has been done to identify how much attention is paid to human factors when designing and developing Web sites or Web-based applications, or to measure awareness of usability issues amongst Web site owners, designers and developers in New Zealand. The purpose of this research was: (a) to identify the current practices for user interface design that are being advocated by researchers and practitioners in the user interface design field worldwide that enable the development of usable Web sites and Web-based applications, (b) to find out the extent to which these practices are being used to design and develop user interfaces in New Zealand Web sites and Web-based applications, and (c) to find out if the six major New Zealand universities are up-to-date in teaching HCI and usability courses when compared to overseas universities in other developed countries.

The findings from this research should:

a. Determine the level of awareness of usability issues among Web site developers and owners in New Zealand.
b. Help to determine the depth of coverage in HCI and usability by major universities in New Zealand.
c. Help to determine if universities in New Zealand have to make changes to their IT curriculum so that more appropriate papers or courses are offered to better equip graduates with knowledge and skill in HCI and usability.

d. Create awareness of the importance of producing usable user interfaces for Web sites and other Web-based applications.

1.2 Research questions

There are user interface design guidelines and rules for Web sites that have been suggested and published by academics and practitioners. If used sensibly, these enable the designers and developers of Web sites to develop sites that are usable, that cater to the needs of users, and meet usability requirements.

This research seeks to answer the following questions for user interface design practices for Web-based applications in New Zealand:

1. Do developers involve usability professionals to design and develop user interfaces? If not, why not?
2. Do developers have separate budget to deal with usability issues? If not, how is usability supported, if at all.
3. Do developers use prototyping to produce designs for interfaces? If so what prototype techniques are used?
4. Do developers conduct user research to gather data about users or do developers design and develop Web sites based on assumptions about the users?
5. Do developers provide personalized service, experience, information or content for individual users of Web sites? If not, why not?
6. Do developers use an iterative design and development methodology? Are there reasons that restrict them from using iterative methods?
7. Do developers use a participatory design methodology to involve users in designing Web sites? If they do, then at what stages do they involve the users? If they do not, what are the reasons?
8. Do developers consider the elderly users in the design and development of Web sites since this is one of the fastest growing user groups?
9. Do developers consider cultural issues in interface design and development?
10. Do developers use guidelines to design and develop user interfaces?
11. What evaluation technique(s) are used for evaluation?

12. Do tertiary education providers provide an adequate level of coverage of interface design in Information Technology courses in New Zealand?

The study was carried out in both the private and public sector, and included companies, organizations, and government departments from the Auckland and Wellington regions, as well as Web development companies. The first survey was sent to a total of 280 companies, organizations and various government departments which have Web presences, and to 80 Web development companies. The survey was based on the recent and current user interface design practices that were identified during a literature review of various journal publications and white papers of well-known practitioners of user interface design such as Aaron Marcus, Jacob Nielsen and Jarred Spool.

The second survey was to establish what is offered in human-computer interaction courses by the six major universities in New Zealand. This survey was sent to Auckland University, Waikato University, Massey University, Victoria University, University of Canterbury, and Otago University. The various human-computer interaction Web sites were identified and used to: (a) compile a list of universities worldwide that offer human-computer interaction education, (b) compile list of universities worldwide that have a reputable usability or HCI laboratory to support teaching and research work, (c) compile a list of private organization worldwide that have a reputable usability or HCI laboratory, (d) compile a list of well known human-computer interaction conferences, and (e) establish if there is a human-computer interaction curriculum proposed for tertiary education providers by any of the renowned worldwide HCI associations.

1.3 Background

1.3.1 HCI

For computer systems to be extensively acknowledged and accepted as a tool to help human beings to accurately, efficiently and effectively perform tasks, they need to be designed to accommodate the capabilities, skills, knowledge and needs of the users for who they are intended.

According to Norman (2000) the psychology of materials such as affordance should provide strong clues about the operation of things. Affordance refers to the seeming and actual properties of a thing – fundamentally those properties that determine how the thing could be used. It is common knowledge to human beings that turning the knob on the door will open it. The internal working that enables the door to open while the knob is turned is of no concern to the person who is trying to get access to the room. Similarly the internal functioning of any computer system is not a concern of any user who uses the system to accomplish a task.

The actual position of the knob on the door, the size of knob, the shape of the knob and other features of the knob will have a bearing on how easy or difficult it will be for someone to open the door to gain access to a room. The design of the knob is agreed upon after various rounds of design and testing with people of various age groups and physical capabilities, who should be able to easily open and close the door using the knob in all situations.

According to Norman the same principles also apply to computer systems – the users of the computer system should be able to easily use it in all situations without any problems that may result from its design. The physical features of the hardware and the features of software such as the appearance and familiarity of various menu items or icons on the screen will determine the attitude of users towards the acceptance of a computer system. The success of an interface depends upon: how quickly the interface responds when the user interacts with it to carry out a task, if the interface is easy to learn, and if the users find it easy to use. If the users find the interface attractive and fun to use, it will be accepted by them.

HCI (Human-Computer Interaction) is the study and practice of usability. It is about understanding and creating software and other technology that people will want to use, will be able to use and will find effective when used. Usability is the measure of the quality of a user's experience when interacting with a product or system, whether a Web site or a software application.

According to Rogers et al. (1994) human-computer interaction is the processes, dialogues, and actions that a user employs to interact with a computer in a given environment. They describe HCI as a discipline that concerns the design, evaluation, and implementation of interactive computing systems for human use, and the study of major phenomena surrounding them. Myers et al. (2000) describe human-computer interaction as the study of how people design, implement, and use interactive computer systems, and how computers affect individuals, organisations, and society.

Human-computer interaction requires an understanding of people who would use the computer program (the users), the domain and institutional structures that might affect how or when they would use the program, the tasks that are carried out, and the software and hardware solutions that could be offered (Johnson, 1992).

According to Rogers et al. (1994) the term human-computer interaction (HCI) was adopted in the mid-1980s as a means of describing this new field of study. Human-computer interaction has only become a hot topic of discussion in the Information Technology sector in the last two decades. Despite its importance, very little effort and resources are allocated to the design and development of the user interface of any information systems project. Research in human factors began in the Second World War so that more effective war hardware and weapon systems could be designed and developed. The Ergonomics Research Society was formed in 1949 due to substantial interest in this area among researchers.

Today the continuous development in the area of information science and technology is playing a major role in highlighting the need for incessant research and development in human-computer interaction. The research and development in human-computer interaction is viewed as very critical if computer technology is to be successfully used to make information available to the public.

The computer technologies that have enabled computer systems to become more user friendly and easy to use for the general public, especially for home and personal use, are the result of research that was done on human-computer interaction technologies by universities, government and corporate research labs such as Xerox PARC (Myers, 1998). The technologies that we currently use with our desktops and portable PCs, like: (a) fundamental interaction styles such as direct manipulation, the mouse point device and windows, and (b) applications such as drawing, text editing, and spreadsheets, are the product of research that started in the early 1960s. According to Myers the continuous research in human-computer interaction technologies such as gesture recognition, multimedia, and three-dimensionality will produces technologies that will have a significant impact on the interfaces of the future.

The endeavour of continuous research and development in human-computer interaction will ensure computer systems and related computer technologies are designed and developed to be usable and safe for the intended users. The goals of human-computer interaction can be summarized as developing or improving the safety, utility, effectiveness, efficiency, and usability of systems that include computers (Rogers et al., 1994).

The term "usability" is a major concept in human-computer interaction and it concerns producing systems that are user friendly – systems that do not leave users frustrated since they are not difficult to learn or use. According to Dix, Finlay, Abowd and Beale (2002), usability is a combination of factors that affect the user's experience with the product or system, including:

(a) Ease of learning – how fast can a user who has never seen the user interface before learn it sufficiently well to accomplish basic tasks?

(b) Efficiency of use – once an experienced user has learned to use the system, how fast can he or she accomplish the basic tasks?

(c) Memorability – if a user has used the system before, can he or she remember enough to use it effectively the next time, or does the user have to start over learning everything again? What are the frequency and severity of the errors that are made by users when using the system?

(d) Subjective satisfaction - how much does the user like using the system?

The studies that were done to determine the benefits of HCI have provided information that design and development teams that took care off of usability issues of their product improved productivity.

A study done by Eason et al. (1988) to examine the benefits that organizations were aiming to achieve by introducing word processing software, (arguably a product of research and development in HCI) , showed improved turnover, greater flexibility and better use of staff. Another similar study done by Wixon and Jones (1991) reported that DEC (Digital Equipment Cooperation) increased its sales in the second release of its applications generator software due to improved usability of its product. According to Rogers et al. (1994) the Three Mile Island nuclear power plant disaster, the Indian Airlines flight 605 airbus 320 that crashed which killed 98 people, China Airlines flight 006 that plunged thirty thousand feet in the Pacific Ocean, US shooting down the unarmed civilian jetliner (Iran Air 655) which killed two hundred and ninety people etc are some of the major tragedies that were reported as result of poor interface design of the computer systems that were used in various situations.

It is widely advocated by researchers in this field that to design a usable and effective user interface of any application multi-disciplinary skills are needed. HCI is classified as a multi-disciplinary field. According to Rogers et al. (1994) major disciplines that contribute to HCI are: (a) cognitive psychology, (b) social and organizational psychology, (c) ergonomics and human factors, (d) engineering, (e) design, (f) anthropology, (g) sociology, (h) philosophy, (i) linguistics, (j) artificial intelligence, and (k) computer science.

Knowledge in cognitive psychology might help to ensure that the system that is to be developed will only require information processing activities that are within the capabilities of the users' mental processing. According to Benyon et al. (1993), cognitive psychology can help to improve the design of computer system by: (a) providing knowledge about what users can and cannot be expected to do, (b) identify and explain the nature and causes of the problems users encounter, and (c) supply modelling tools to help build more compatible interface.

According to Rogers et al. knowledge in social and organizational psychology: (a) provides insight into the structure and working practices of businesses and institutions, (b) identifies and explains problems resulting from changes to work practices, (c) provides understanding of attitudes of computer use and implementation, and (d) suggests methods by which an organization can restructure to improve the quality of working life. They say that the discipline of ergonomics or human factors helps to define and design tools and various artefacts to suit the capacities and capabilities of users. It ensures safety, efficiency and reliability while making a task easier to perform and also ensuring comfort and satisfaction.

According to Rogers et al. the engineering discipline, which basically involves processes, model building and empirical design testing, and helps to build artefacts while the discipline of design contributes creative skills and knowledge to support the design of those artefacts. According to them linguistics helps to understand several issues in HCI by applying knowledge and theories from it. Knowledge from the field of artificial intelligence helps to understand the users' needs when interacting with an intelligent interface.

Rogers et al. say that the fields of philosophy, sociology and anthropology provide methods developed in these areas that can applied to the design and evaluation of systems. According to them it helps to provide more accurate descriptions of: (a) the interaction between users, (b) their work, (c) the technology that they use, and (d) the environment in which they are situated.

One of main contributions of computer science to HCI is to provide knowledge about the capability of technology and ideas about how this potential can be tied together with providing various kinds of methodologies for software design, development and maintenance.

Thus, effective interface development is a multidisciplinary process, which requires a holistic view applied to provide solutions to design problems. For user interface design and development more skills are required than any single individual is likely to possess.

HCI is very much concerned with design, by providing designed solutions to identified problems taking full account of all the constraints and requirements. The design aspect applies to entire systems, i.e. the software, hardware and the users. The purpose of the design is to enable work and other activities to be performed more effectively, efficiently, with more enjoyment, and satisfaction.

1.3.2 The User Interface

User interface is the tool that enables users to use computer systems to accomplish their tasks. According to Raskin (2000), the user interface is the way that you accomplish tasks with a product, i.e. what you do and how it responds. While there is an ever growing range of new technological products that are launched in today's marketplace, products like computers, watches etc. have greater functionality, but the interfaces of these products have become more complex.

Raskin says that an interface is humane if it is responsive to human needs and considerate of human frailties. If humane interfaces of software products are to be created, the developers, designers and the owners have to be aware of and understand the relevant information on how both humans and machines operate. These people must understand the likely difficulties or problems that users will face and experience when they use a computer system.

The notion "user interface" was adopted in the 1970s when there was a technology explosion. The developers of computer systems become aware that if their products were to be successful in the marketplace then these systems have to be easy for people to learn and use.

According to Rogers et al. (1994), this new dimension led to a greatly overused cliché – calling a system 'user friendly', which in practice simply meant tidying up the screen displays to make them more aesthetically pleasing and paying lip service to real issues surrounding HCI. But they say that academic researchers were concerned about how the use of computers might enrich the work and personal lives of people, in particular, they focused on the capabilities and limitations of human users. And as the HCI field began to develop it soon became clear that other aspects relating to users such as training issues, work practices, management and organizational issues and health hazards were all important factors contributing to the success or failure of using computer systems.

1.4 Outline of the study

The report of this research also includes chapters on a literature review, the methodology that was used to conduct the research, the results of the research, analysis and discussion of the results, conclusions, and recommendations.

Provided in the literature review chapter is a review of publications on issues, practices and guidelines to do with user interface design. The methodology chapter describes how the research was carried out using survey methods. The results chapter presents the findings of the research in table form so that the results can be easily interpreted. The discussion chapter provides descriptions of the interpretations of the results. Described in this chapter is how the results are related to the literature review. The conclusion chapter provides a summary of the main parts of the research and provides information on what results were achieved. The recommendation section includes what needs to be undertaken to improve the usability of Web sites and Web-based applications in New Zealand.

Chapter 2

2.1 Literature review

2.1.1 Introduction

The challenge that faces designers and developers is to design Web sites and Web-based applications that will meet the needs and requirements of target audiences with diverse backgrounds and abilities on the Web. Usability is a necessary condition for survival and there needs to be continuous research and development so that proper processes, methodologies and techniques are established with proven results, and if adopted sensibly will enable designers and developers to create usable interfaces. Various publications on human-computer interaction (HCI) and user interface design have been selected to help identify good user interface design practices. This chapter presents the findings of literature review.

2.1.1 HCI tools

2.1.1.1 Introduction

Designers and developers need the support of software tools to quickly learn about and understand design ideas, and to communicate with stakeholders. They also require software tools that enable them to quickly develop user interfaces for Web sites that will meet all the usability requirements of the target audiences.

Based on the usage of pen, paper, walls and tables for explaining, developing, and communicating ideas during the early phases of Web design, Klemmer, Newman, Farrell, Bilezikjian and Landay (2001) propose a design tool called "The Designers' Outpost" which allows users to collaboratively author Web site information architectures on an electronic whiteboard using physical media (post-it notes and images), structuring and annotating that information with electronic pens.

Newman and Landay's (2000) study of Web site design practice found out that designers employ multiple design tools during the course of a project, including graphic design, Web development, presentation, and word processing software, as well as pen and paper. They reveal that sketching on paper is especially important during the design exploration phase of a project, when designers wish to explore many design possibilities quickly without focusing on low-level details. Based on their findings they outlined features for informal computer-based tools to support early-phase Web design practices and introduce an application that would support early-phase Web design practice.

Iterative design and implementation is now seen as critical to the success of many user interface development efforts. In order to make iterative design a practical reality, one of the major goals of the last 15 years of user interface tool research has been to make it possible to rapidly produce high quality interfaces, which has been very successful (Hudson, John, Knudsen and Byrne, 1999). According to them it is now possible to use widely available commercial tools such as Visual Basic to create graphical user interfaces in a small fraction of the time it would have taken a decade ago.

Myers, Hudson and Pausch (2000) consider cases of successes and failures in past user interface tools and extract themes, which according to them can serve as lessons for future design and development of user interface development tools. They believe that user interface design is poised for a radical change in the near future, mainly brought on by the rise of ubiquitous computing, recognition-based user interfaces, 3D, and other technologies. They firmly believe that user interfaces are about to break out of the "desktop" box on to various diverse computerized devices such as PDAs, cell phones, pagers, computerized pens, computerized notepads etc, and there would be a resurgence of interest and research on user interface software tools in order to support the new user interface styles.

Hakim and Spitzer (2000) say that while the idea of prototyping has been around for the last ten to fifteen years the tools that have been used for prototyping software and Web applications were not explicitly designed to support prototyping. According to them, what they want is a simulation engine for networked software products, which would allow them to create Web products and services that mimic the functionality and behaviour of the planned products or services. They describe the simulation model as a working model of a system created with materials that are cheaper or easier to manipulate than those with which the target product will be built.

According to Hudson, John, Knudsen and Byrne (1999), user interface design tools will enable the implementation of user interface more quickly but the lack of tool support for user interface design evaluation means that evaluation still takes a long time in relation to overall development time. They describe a technique called CRITIQUE for automatically generating predictive performance models from the tasks.

Kieras, Wood, Abotel and Hornof (1995) describe the usefulness of the engineering model GOMS that enables designers to predict the usability of the procedural aspects of interface designs. They describe GLEAN (GOMS Language Evaluation and Analysis), a computer-based tool that generates quantitative predictions from a supplied GOMS model and a set of benchmark tasks. They found that GLEAN reproduced the results of a case study of GOMS model application with considerable time savings over both manual modelling and empirical testing.

Prototyping tools are only useful when used correctly as part of a complete design process. According to Munoz (1992), based on his experience of developing and using many prototyping tools, many such tools have little impact on the usability of a product. According to him many high fidelity tools concentrate on details, such as what order the menu items should be in, before a good understanding of the user's needs is acquired. He says that there are no interactive prototyping tools that allow the easy integration of design knowledge acquired using low fidelity techniques. He says that prototyping would be more useful if designers allowed prototyping of the functional parts along with the user interface.

According to Spool (1992), the problem is not rooted in the prototyping tools themselves, but the process in which they are employed. He says that a prototype is effective when it allows the viewer to give pertinent and productive feedback back to the developer, and low fidelity prototyping techniques can be employed to give quality feedback during early stages of development.

The tools and methods cut the amount of effort and time required to develop a system, which can represent a significantly high percentage of the overall effort devoted to the development of any system (Holt, 1991).

2.1.1.2 Conclusion

Various studies suggest that HCI tools play an increasingly important role in the development of user interfaces. HCI tools help reduce the amount of code that developers and programmers need to produce when creating a user interface, and they also allow user interfaces to be created more quickly. There seems little doubt that in the future, HCI tools will contribute significantly to the attainment of high usability. In the future, there will be more interest in, and more effort put into creating new HCI tools for designing and developing user interfaces for Web sites and Web-based applications. These tools will be accessed via various hand-held computing devices.

2.1.2 Conceptual Model

2.1.2.1 Introduction

Knowledge and understanding of how people think and perform activities or tasks helps designers to decide what features should be provided for, which the users will be able to easily relate to and understand within the Web site or Web-based application. Designers need to have relevant education and training so that they are able to acquire this information about users, and are able to use it to base their design decisions upon.

Norman (2000) says that to provide a quality user experience for the users when they interact with any computer system, Web site or device the developers have to understand the psychology of everyday things of humans. According to Norman the principles of visibility, appropriate clues and feedback about one's action constitute a form of psychology - the psychology of how people interact with things. Norman suggests that the psychology of materials such as affordance should provide strong clues about the operation of things. Affordance refers to the seeming and actual properties of a thing – fundamentally those properties that determine how the thing could be used.

Norman states that there are twenty thousand everyday things and it is the way the mind works, i.e. the psychology of human thought and cognition that enables people to cope. Norman implies that fundamental principles of designing for people are providing a good conceptual model and making things visible. According to him a good conceptual model would allow the user to predict the effects of his or her actions. He says that a device is easy to use when the set of possible actions is visible, and a good design takes care of this. Norman concludes that the paradox of technology should never be used as an excuse for poor design. He says that the number of options and complexity of controls should be managed by good design practices.

The use of conceptual models for designing user interface is also supported by Johnson & Henderson (2002). According to Johnson & Henderson the conceptual model is the bone of the design. They say that the conceptual model is much smaller than the whole design, and is something that can be held in the mind and worked on. Once the conceptual model is designed, all other design and implementation activities can and should be based on it, feeding it with task scenarios, and building on it (the user interface, lexicons, implementation, documentation and evaluation). According to them the conceptual model is so central, it is important to ensure that everyone agrees on it and that all changes must be made jointly since changes that affect the conceptual model affect everyone.

Gunaratne (1999) raises issues that must be examined and the approaches that could be used to improve the interface design in order to make user interfaces error-resistant, productive and user friendly. He says that knowing user characteristics, experience, personality types, age and gender of users are important in designing a human-machine interactive system. He says that the use of a conceptual model, enables designers to cut down the amount of time spent on HCI development, and also enables designers to select the best design after the evaluation of several alternatives. He says that to develop a conceptual model, it requires the study of user expectations, analysis of user tasks, and to organise the conceptual model to match the users' understanding of the task.

2.1.2.1 Conclusion

Various studies show that a good conceptual model of users is required in order to design usable Web sites or Web-based applications. A conceptual model provides clues as to how people perform everyday activities. Basing design ideas on a conceptual model ensures that features used within the application will not be alien to users.

2.1.3 Task Analysis

2.1.3.1 Introduction

Key to successfully designing a usable interface is learning about the work that users would do using the Web site or Web-based application. Task analysis enables developers to have a good conceptual understanding of: (a) what users would want to do, (b) what users would want to achieve, and (c) what range of skills the users are likely to possess.

According to Arnowitz, Fijma and Verlinden (2000), task analysis is often considered the most essential step in the design process of a quality user interface. But they say that most representations of task analysis diagrams are often too specialized and obscure to be widely understood. They say that to involve a multi-disciplinary team in a dialog design and concept development phase, a complementary drawing technique is required. They say that this would give alternate views, and would be easily understood. Using techniques borrowed from the study of parallel processing, Arnowitz et al. developed a technique of task analysis representation called task layer maps. According to them the task layer map technique is quick and easy to understand, which enables the design team to quickly come up with dialogue design. The task layer map also allows the design team members to easily add their own ideas and creativity to the design process.

But how do developers distinguish: (a) what is truly necessary to support work from what users may say that they want, or from what developers are by habit prepared to offer? (b) how they can describe and represent the tasks? and (c) how this understanding can be used to develop the user interface to support the tasks? According to Constantine and Lockwood (1999) use cases are a particularly versatile form of task model. They say that a use case comprises a single case of use of a system that is complete, well defined, and meaningful from the perspective of an external user. According to them the structured narratives of use cases can be interrelated through formally defined constructs to form a comprehensive model of the tasks to be supported by a system under design.

Constantine (1995) says that it is essential to make use of use case modelling since it can be used within almost any user-centred design strategy. He says that use case modelling is neither a methodology for user interface design nor a substitute for user-centred approaches, but a process that augments and facilitates user-centred approaches. Constantine says that use cases are particularly effective as a medium for communicating with users about their work, and the system requirements to support that work. Another benefit is that users do not need to learn a new language or specialized set of modelling conventions to understand essential use case narratives. According to him these are expressed in the language of the user and are completely self-explanatory.

Bomsdorf and Szwillus (1999) say that there are different models used in task-based user interface design. They say that the more formally the model (the current task model, envisioned task model, user interface model, and implementation model) is defined, and the closer it is related to the interface, the more can be generated by means of tools. On the other hand, more creativity is required to turn one model into another than only fewer rules for transformation can be defined.

They say that to make task-based user interface design more applicable for real projects, tools support is necessary that will take into account the various models, and the different qualities of their transition. But they say that key to the success of tools in supporting task-based user interface design is a flexible and expressive formalism that is able to capture the most relevant aspects of an interface design.

But according to Albers (1998), for jobs that consist of routine actions that are well-structured, task analysis work well, and when the task is not well defined or well structured then attempts to describe step-by-step actions break down, because no single route to a solution exists. Albers points out that there is a difference between the task analysis of structured tasks and unstructured tasks since the users have different goals to accomplish.

Albers says that in a structured task environment, the user's basic goal is essentially to efficiently complete the task, whereas with an unstructured task, the user's goal is problem solving and decision-making. He says that when solving a problem, the user's initial difficulty is recognizing what is wrong, and what information is needed to verify the problem and suggest possible solutions. He explains how workload, time stress, inexperience at solving problems and many other factors can affect decision-making ability, and describes how goal-driven task analysis addresses these problems at the beginning of the design process by focusing on the interrelationships between information and how those interrelationships fit into the user's mental model.

Albers says that providing the users with high levels of situation awareness requires changing from conventional task analysis to goal-driven task analysis. According to him goal-driven task analysis must identify the major goals and the sub-goals necessary to meet the user's real-world goals and provide a relevant view of the current situation. Albers says that besides just defining the information needs about how the user integrates the information, how it fits into the user's mental model of the process needs to be addressed if situation awareness is to be supported.

The intention of an interface is to make a system compatible with or usable for the user. Often the designers and developers find it difficult to design and develop user interfaces that meet each specific individual user's needs and requirements. Marti (1996) says that task analysis and task modelling are considered to be major human factors tools for structured user-centred and task-centred methodologies. According to Marti it involves: (a) adapting the system to the human beings who use it, (b) raising psychological issues concerning human memory, (c) perception, and (d) conceptualisation.

Marti provides accounts of how a task-centred design approach was used to develop CHARADE, a software platform for the development of decision support systems in the field of environment emergencies, whose primary application is forest fire fighting. Marti describes the effective exploitation of task analysis and task modelling during the development process of CHARADE, highlighting the methodological steps that allow direct contributions to the design and evaluation.

Usability problems arise when there is a mismatch between a user's understanding of the task they are performing and the system model. According to Wilson and Johnson (1995) the task-based design enables designers to produce an implicit system model that is compatible with the work it is intended to support. They say that in order to achieve this, the designers must be in a position to make design decisions based on an informed understanding of users' work, rather than on assumptions and ill-informed misconceptions. They say that representing users' tasks forms the basis for the design of an interactive system.

According to Wilson and Johnson the most important thing in the design process that involves task-based design is the evaluation at each design phase that involves the users. They say that the more knowledge about user tasks is available during design time, the more it can be exploited when defining the system's properties and features, which leads to a higher degree of user acceptance and user satisfaction.

2.1.3.2 Conclusion

Various publications on task analysis show that task analysis provides a good understanding for designers and developers of what tasks the users would perform using the Web site, what steps would be involved in each task, and the order of steps in each task. Task analysis helps designers to identify likely usability problems and any missing functionalities which may limit the use of the Web site or Web-based application. Arnowitz et al. (2000) argue that task analysis would be more effective if it involved task layer maps, while Albers (1998) suggests that for unstructured tasks, goal-driven task analysis is most suitable.

2.1.4 User research

2.1.4.1 Introduction

The most valuable asset of a successful design team is the information they have about their users. User research enables designers to learn about who their target audiences are, what level of expertise they have, what limitations they have, and what their computing environment is like. This information enables designers to design and develop Web sites and Web-based applications based on facts, rather than on assumptions about what will work for users.

According to Nielsen (2003c), knowing the real-world facts increases the creativity because it offers designers ideas about design improvement, and inspires them to focus their energy on real problems. He says that the main benefit of letting user research drive design is that designers do not have to spend time on features that users do not need, and also early user studies show where to focus resources so that the developers can ship products on time.

Merholz (2003) says that when they recruit users, the goal is to select users who would be likely to use their client's site or product, and observe enough of them so that trends emerge from their collective behaviour. Their designs are based on these user trends. He says that while it is impossible to study every potential user, the first step should be to identify the key audience types, the next step is to observe enough users to ensure that behavioural trends are uncovered, and the final step is to use recruiters to recruit the right people for focus groups.

One way to cater to the needs and requirements of all your users is by grouping them into various user groups. Spool (2003b) says that it is important to identify the expertise of users before you actually start to develop software. According to him the users can be grouped into core users or ring users. He says that core users like to use an application to extend their existing core knowledge, whereas ring users could use applications to do their jobs better, but the functionalities of the ring applications are beyond the users' core competencies. Spool says that the users of ring applications usually accept all of the applications defaults and standard configuration settings. According to him the users of ring applications will need concepts and jargon explained in plain language.

When teams have the right user information, the job of designing a powerful, intuitive, easy-to-use interface becomes tremendously easier (Spool, 2003c). Spool says that it is the field studies that enable the design team to be immersed in the environment of their users, and allow them to observe critical details that cannot be discovered in other ways.

According to Spool (2002a), fundamental user research is missing from current user interface design practice. He says that this kind of information is very critical to the development of usable systems. He says that designing through iteration is the best technique that developers can use to design and construct useful and usable interfaces. Spool's idea is that every designer should know what a usable design will look like before they have started building the interface, and he says in order to achieve this, how design affects behaviours has to be understood.

User studies enable the designers to learn user characteristics on which they should base the design of their user interfaces. According to Spool knowing your users is the mantra of any good designer. He says that the users' intentions, context, knowledge, skills and experiences are the essential things that every designer needs to know. According to him it helps to provide the right context for the users. He says that these five attributes are critical to quality design experience. It is information gathering and analysis of user information that provides designers with a basic understanding of the users of the Web site under development. Spool says that techniques like contextual inquiry, persona development, and mental model analysis can make or break a team's design effort. He says that without these the designers will fail to provide quality user experiences within Web sites.

Drop-off data is a valuable measure in gauging potential missed opportunities (Hynes, 2002). He says that drop-off data can help in identifying areas for improvement, and as a key metric in calculating the return on investment. But he says that it is important to understand that drop-off data is not a simple number that communicates a single clear message. According to Hynes, to fully dig into the actual casual factors the scientific research must be conducted with users through surveys, focus groups, field studies, usability testing, and other methods that get at the real reasons why users leave Web sites.

User support is an important element in reaching the goal of universal usability for Web information systems (Aberg and Shahmehri, 2001). According to them their empirical findings show that integrating human assistants into Web systems is a way to provide efficient user support. They say that the integration makes a Web site more fun to use, improves the site atmosphere and increases the user's trust in the site.

User study is also advocated by Israelski (2000), who says that companies that enjoy Web success do a thorough study of their user's needs and behaviours, and pay serious attention to the human factors of design. He says that it takes a systematic approach to incorporate human factors into a complete set of user-centred solutions. According to him the developers need to systematically research information about who needs to access the site, and what their goals and objectives will be in using the site. He says that analysts gather user data by using observations, questionnaires, interviews, and focus groups of a cross section of the Web site's intended users.

Identifying and learning about the various user groups enables the design team to design and develop Web sites that meets the needs and requirements of the users. Hysell (1998) explains how OCLC's (Online Computer Library Center) Web site was designed to meet the needs of diverse users by providing choices in language, file format, navigational methods, and the delivery of new content notification.

From a few hundred users accessing it each week, it has grown to have more than twenty thousand weekly visitors that have brought problems such as: (a) handling an increased volume of information, (b) accommodating increasing diversity in distribution media, (c) providing more customization to users, and (d) accelerating the availability of information in other languages while minimizing translation costs. According to Hysell, Web technology has highlighted the need for OCLC to move from a static, document-centred approach to one that is dynamic and information-centred. She says that to be an effective information service, the OCLC Web site must help users find relevant information without forcing them to become an expert in the way the site is organized.

The World Wide Web provides a very large information space for users, who need appropriate information access methods together with information delivery methods that enable them to make full use of this vast information space. Thomas & Fisher (1997) present a prototype BASAR (Building Agents Supporting Adaptive Retrieval) that provides users with assistance when managing their personal information space. Their prototype BASAR is based on the following features: (a) active views, (b) Web assistants, and (c) usage profiles. The assistance provided is user-specific. In BASAR users can create a personal information space along a semantic meaning that is independent of the WWW-viewer. The Web assistant supports adaptive filtering, creating active views, and locating and accessing relevant information. It has knowledge about the network, which is stored in the usage profile in three parts: user-specific, task-specific and domain-specific.

Crow and Smith (1992) argue that adaptive systems are necessary since single interfaces will be inappropriate for most users in any reasonably large and diverse user population. They say that it is necessary to built adaptive systems, which adapt interfaces to an individual user based on observations of that user rather than building interfaces that contain stereotypes of users.

2.1.4.2 Conclusion

Studies by various researchers show that user studies are an absolute requirement in the design and development of Web sites and Web-based applications. They enable the design team to learn about and understand the capabilities, needs and requirements of the target audiences. The functionalities and the features of the Web site or the Web-based application should reflect these findings about the users. User studies enable the designers to accurately determine the kind of support or help that should be provided to make the Web site usable for the target audiences.

2.1.5 Personalization

2.1.5.1 Introduction

While the Web provides users with alternatives and choices, personalization is seen as key to maintaining a long term relationship with customers on the Web. One way to ensure that users will regularly come back to a Web site is by providing personalized service according to the individual user's needs and requirements.

The continuous growth in the size and use of the World Wide Web imposes new methods of design and development on online information services (Eirinaki & Vazirgiannis, 2003). According to them, personalisation can be used to predict user needs in order to improve the usability and user retention of a Web site. Eirinaki and Vazirgiannis provide in detail the processes and techniques that are involved in personalization, such as: (a) ways to collect user data, log analysis, Web usage mining, and content management, (b) ways to analyse the collected user data, (c) ways to create user profiling, and (d) creating customised Web pages.

Fink, Koenemann, Noller and Schwab (2002) describe how the Kirch Group provides personalized news items for managers who need accurate real-time information delivery in the areas of investment, business, politics, and sports. The Kirch Group's personalization is managed by the humanIT Personalization Server that provides essential user-modelling services to the user-adaptive applications.

Ardissono, Goy, Petrone and Segnan (2002) describe SeTA (Sevizi Telematici Adattativi) which is a toolkit used to create Web-based stores that provide tailored service and information for customers according to customer needs, interests and physical capabilities. They performed a subjective evaluation of SeTA in their laboratories and found out that users liked the personalized features of the system. This system creates a customer model and uses template-based natural language generation techniques to present the content to its users. SeTA uses stereotypical information about the customer and analyses the user's behaviour to build and update the user model.

Personalization is based on data provided by users or data collected and analysed based on the browsing behaviours of the users. Padmanabhan, Zhebg and Kimbrough (2001) suggest that clickstream data, which is collected at site (site-centric data) based on the browsing behaviour of the users, is inherently incomplete, since it does not capture the browsing behaviour of users across sites (user-centric data). Models derived from site centric data have limitations since their experiment revealed that the models derived from the user-centric data outperformed the models derived from clickstream data for predication tasks.

Anupam, Hull and Kumar (2001) describe a new technology based on on-line decision support for providing personalized customer treatment in Web-based storefronts and information sites. It is based on specifying decisions based on a language that incorporates flowchart constructs, rule-based constructs, and a variety of specialized constructs to facilitate reasoning based on heuristics and partial information. They illustrate the benefits of their approach by describing a prototype system know as May-I-Help-You (MIHU) that monitors the customer's progress through the storefront, and may choose to proactively intervene in order to help close a sale.

Since personalization is a critical aspect in many popular domains such as e-commerce, it is important enough that it should be dealt with from a design view, rather than just an implementation view (Rossi, Schwabe & Guimaraes, 2001). They present the OOHDM approach for specifying and designing personalized behaviours in Web applications. They present their notation in a broad range of customisation cases to show how they can build different Web applications for different profiles by just reusing a conceptual schema. According to them a finer grained personalization can be obtained by specifying individual contents such as recommendations, and customized prices etc.

According to Anderson, Domingos & Weld (2001), ninety-five percent of cell phones that were sold in 2001 were "Web-ready", and authorities predicted that the number of wireless Internet devices would have outnumbered desktop computers by 2003. According to them, only a few Web sites in 2001 catered for mobile visitors, instead optimised their content exclusively for desktop clients. Anderson et al. propose building Web site personalizers that automatically adapt and personalize a Web site to each individual mobile visitor. The Web site personalizer is an intermediary between the Web site and the visitor, and is situated on the Web server on the visitor's device or at a proxy server in between. They say that it can: (a) make frequently visited destinations easier to find, (b) highlight content that might interest the visitor, and (c) avoid uninteresting content and structure.

According to Riecken (2000), personalization is about building customer loyalty by building a meaningful one-to-one relationship by understanding the needs of each individual, and helping to satisfy a goal that efficiently and knowledgeably addresses each individual's needs in a given context. He says that personalization must be realized in all user interfaces, whether they are on the Internet, brick-and mortar, or in call centres. According to him, personalization does not require a service or product to be able to identify each user. He says that any given service could be designed and deployed to address the needs of a group of users with similar needs.

The Web presents the opportunity to capture vast amounts of user data such as browsing behaviours, purchase history, and financial activities etc. The ability to design, implement, and maintain user interfaces and user navigation for personalized interactive services requires defining meaningful metrics and collecting appropriate feedback (Schonberg, Cofino, Hoch, Podlaseck & Spraragen, 2000). They say that data captured serves two important functions: (a) it can be used to nature loyalty, and (b) it can be used to evaluate user interfaces for their effectiveness in meeting user needs and desires.

Schonberg et al. use the term "E-business Intelligence" which they describe as the analysis and use of information collected about visitors to an e-business Web site. They say that to measure success it is important to understand what success means, i.e. what the goals of the Web site are, and how to use metrics to evaluate the success with which these goals are met. They describe two metrics: (a) clickthrough, and (b) look-to-buy. According to them the ability to collect and combine customer data from multiple sources enables richer analysis.

According to Schonberg et al., the metrics: (a) may suggest where the improvements can be made with regard to design, layout, and navigation issues, (b) can also be used to create visualizations that capture the visitor's behaviour in ways that may otherwise be missed, (c) reveal Web traffic, (d) can be used to build loyalty programs for frequent visitors, and (e) can enhance the user's experience. They say that even with profiling, Web site owners will not be able to escape the task of designing a clear, usable, memorable, and reliable Web site that considers all aspects of a visitor's experience.

Manber, Patel and Robison (2000) provide some general observations and lessons that they have learned in providing personalization with Yahoo. They point out that most users take what is given to them, and never customize. According to them, this may be due to their default page, which they regard as good, or that their customization tools are difficult to use, or that many people do not need complex personalization.

According to Manber et al. a great deal of effort should go into making default pages as strong as possible. They say that people generally do not understand the concept of customization since people are not accustomed to computers presenting surprising and seemingly intelligent results, because people are accustomed to things being static. They say that it is important that the designers learn from the users.

Virtually all personalization technologies are based on the idea of storing as much historical customer session data as possible, and then querying the data store as customers navigate through a Web site (VanderMeer, Dutta & Datta, 2000). But as more and more customers visit e-commerce sites, and as e-companies gather increasingly larger amounts of information from each customer visit, the size of the data warehouses storing all this information continues to grow as well. They say that this has resulted in all the personalization and customer relationship management technologies on the market relying on one of two basic techniques: (a) delayed responses, and (b) static profiling techniques that fit customers into one of a small number of predefined static profiles. VanderMeer et al. present a notation for dynamic profiling using the eGlue server that impacts storage and retrieval from data warehouses, as well as caching.

Web Browser Intelligence (WBI) is an implemented system that organizes agents on a user's workstation to observe user actions, proactively offer assistance, modify Web documents, and perform new functions (Barrett, Maglio & Kellem, 1997). They say that WBI can annotate hyperlinks with network speed information, record pages viewed for later access, and provide shortcut links for common paths. According to them, in this way WBI personalizes a user's Web experience by joining personal information with global information to effectively tailor what the user sees.

According to Farrell (2001) there are too many things that stand in the way and make personalisation a risky business. He says that whilst the users may be vocal in demanding what they want, they may have difficulty in identifying what they actually need. He says that this can cause particular problems when applications or sites enable users to manipulate the interface directly. He says that the end result is undesired features, with little thought to the overall structure of the interface and the relative prominence of interface elements.

Others who also think that personalization should take a back seat are Kramer, Noronha and Vergo (2000). According to them it is the user-centred design methods that maintain a strong focus on bringing value to the end user. They say that a designer, who sets out to personalize an existing application, or to build a new personalized application, is poised to make the classic error of putting technology before the needs of the end users. They say that personalization is currently best viewed as an evolving set of tools. Kramer et al. (2000) say that when designers do testing, measuring and iterating on a design, with an unwavering focus on delivering value to the end user, this helps to insure the success of the application usage.

Web personalization is much over-rated, and mainly used as a poor excuse for not designing a navigable Web site (Nielsen, 1998). Nielsen suggests that the real way to individualized interaction between users and the Web is to present the user with a variety of options, and to let the user choose the options that suit him at that particular point in time. He says that natural intelligence, rather than artificial intelligence, enables users to achieve optimal information. According to Nielsen the natural intelligence approach only works if the choices are: (a) easy to understand, and (b) comprehensive in their coverage of the things the users want and need.

2.1.5.2 Conclusion

Researchers in user interface design view personalization as important since it helps improve the usability of Web sites and Web-based applications by providing products, services, information and features according to an individual user's needs and requirements. While personalization for ecommerce sites is regarded as critical for customer retention, some researchers such as Farrell (2001), Kramer, Noronha & Vergo (2000), and Nielsen (1998) argue against personalization and recommend other methods to cater for an individual user's needs.

2.1.6 Prototyping

2.1.6.1 Introduction

Prototyping is recognised as an effective way of testing early design ideas with the target audiences to check what features and functionalities of a Web site or Web-based application are likely to work well for the users. However, on most occasions, low fidelity paper prototypes are not an integral part of the Web site design process since they are not regarded by designers and developers as being as reliable or effective as high fidelity prototypes for producing useful test results.

The ability to take a vision, quickly mock it up, and present it for critique and evaluation is critical to developing quality and usable designs (Spool, 2003d). Prototypes are most valuable when teams can iterate quickly. According to Spool, talking about an idea, trying it out, discovering flaws, modifying the design, and trying it out again, is the essence of an iterative approach to design. If the design takes too long to prototype and modify, then the prototype tool quickly loses its value. Spool advocates Cascading Style Sheets for creating prototypes of Web-based applications, which allows for very fast design changes.

Spinuzzi (2002) describes how prototyping is viewed in Scandinavian countries as compared to the US. Information designers on both sides of the Atlantic have began to employ prototyping as a way to involve users in design approaches for participation and feedback, but Spinuzzi presents information that suggests that prototyping is seen as meeting very different needs in Scandinavia and in the US.

Spinuzzi provides a description of several prototyping techniques that are used in Scandinavia and the US, such as: (a) mock-up, (b) cooperative prototyping, (c) CARD, (d) PICTIVE, and (e) contextual design. According to Spinuzzi the mock-ups which are used in Scandinavia are based on the Marxist theory where the union has a say who represents the users, whereas the contextual design that is used in US is clearly capitalist as the managers select the user representatives for design purposes. Spinuzzi says that the Scandinavian approach ensures that the users become designers whereas the contextual design only encourages the users to critique the design.

Spinuzzi provides several major benefits of using the Scandinavian approach, which they see as bringing democracy in design and development. Spinuzzi describes contextual design as a well-developed set of techniques for: (a) examining a workplace, (b) gathering requirements, and (c) developing solutions based on those requirements.

Buchenau and Suri (2000) suggest that experience prototyping should become an established and well-supported tradition within design practices. They say that this approach can help designers: (a) to be more sensitive, (b) design better experiences for people, and (c) be more convincing about the value of their design decisions, by intentionally adopting this approach. They define experience prototyping as any kind of representation, in any medium that is designed to be understood, explored or communicated. They have identified three different kinds of activities within the design and development process where experience prototyping is valuable: (a) understanding existing user experiences and context, (b) exploring and evaluating design ideas, and (c) communicating ideas to an audience.

Designing large World Wide Web sites can be a very complex task if not supported by a suitable theoretical model (Bochicchio & Paiano, 2000). Bochicchio and Paiano describe JWeb (a design/prototype environment) for prototyping Web-based applications. They argue that it is necessary to have a good design model, which enables the designers to precisely formulate, discuss, and revise their ideas without actually starting the implementation. They also present features of the JWeb design environment to show that it provides fast prototyping capabilities.

Unlike their counterparts in the manufacturing sector, software and Web designers have not had the luxury of equivalent prototyping capabilities. As a result, companies moving services to the Web have often failed to directly address the real customer requirements (Hakim & Spitzer, 2000). Hakim and Spitzer say that they for years they encountered three common problems when they led development teams according to traditional rules: (a) "that's what I said but not what I meant", (b) the features provided by the system were confusing to the users, even though they were requested by the users themselves, and (c) the population included in the evaluation was not sufficiently representative of the target audience.

These problems led them to include team members with backgrounds in information architecture and human factors, and to adopt a more user focused development process. This process starts by describing personas that describe representative users of the planned product, and then classifying real users according to the personas they represent and populations to which they belong. Then they describe the series of scenarios that describe the goals that members of their user community will want to use the product to achieve. After that, the prototype is built to reflect their understanding of the required functionality. They go through several prototype cycles, where each cycle is used as a mechanism to establish a dialog with their clients.

The benefits that they experienced using the prototypes were: (a) the early cycles of prototype served as a mechanism to expose the full scope of task requirements, (b) they enabled them to assess the viability of alternative user interface solutions to the tasks included in the application, (c) they served as a vehicle to enable users and designers to develop a common language, (d) they helped identify relationships between tasks and functions that should drive control grouping within and amongst the screens, (e) they helped to gain insight into how the requirements of different population segments differ, and (f) they helped to avoid endless design discussions about what customers would use, how they would use it, and what would be appropriate tradeoffs.

Prototypes are mainly introduced in the most vulnerable and least settled activities in a software project, i.e. in the analysis and design phase (Schneider, 1996). He says that prototypes are supposed to foster clarification of requirements and to develop and try out solution concepts. But he says that many prototypes turn into the private toys of their developers, where undocumented prototypes are demonstrated and explained only a few times, and there is little chance to learn more than what has been said in the demo.

According to him, leaving the prototypes undocumented is acceptable to the leaders of development teams, and he provides reasons as to why prototypes should be left undocumented: (a) documentation slows down the prototyping process, (b) updating documentation seems to create a tremendous overhead since prototypes are often developed in an "evolutionary" fashion, changing faster than any systematic documentation approach can possibly follow, and (c) many prototypes are supposed to be abandoned since they are considered as "dirty", low-quality software.

Sefelin, Tesheligi and Giller (2003) did a study to investigate the difference between computer-based and paper-based low fidelity prototypes. They found out that: (a) paper-based and computer-based low fidelity prototypes lead to almost the same quantity and quality of critical user statements, and (b) subjects prefer computer prototypes. They provide reasons when to use paper-based prototypes: (a) when the available prototyping tools do not support the components and ideas which the developer wants to implement, (b) when you do not want to exclude the members of the design team without sufficient software skills, and (c) when the tests should lead to a lot of drawings, which can be discussed with the design team.

With a paper prototype, you can user test early design ideas at an extremely low cost. Doing so lets you fix usability problems before you waste money implementing something that does not work (Nielsen, 2003c). According to Nielsen, paper prototyping is one of the fastest and cheapest techniques you can employ in a design process, but he says that paper prototyping is not used because people do not think that they will get enough information from a method that is so simple and cheap to use.

Grady (2000) describes how paper prototypes were used to design and evaluate Mercer University's Web site until their evaluation indicated there would be no likely usability problems. Through the experience gained by conducting usability testing, Grady concluded the following regarding the paper prototyping: (a) usability testing with paper prototypes was inexpensive, (b) both the users and designers appear to be willing to suggest changes to the prototype, even though the changes may be quite significant, (c) it allows for multiple testing with a small set of users, is more useful for identifying problems than elaborate testing, (d) it allows designers to separate content from visual design, and (e) it was an excellent way to introduce usability issues and user-centred design to students.

Virizi, Sokolov and Karis (1996) conducted two different experiments to find out the number of usability problems that are identified by the low-fidelity prototype as compared to the high-fidelity prototype. Their findings revealed that the low-fidelity prototype was as effective as the high-fidelity prototype at detecting likely usability problems.

According to Virizi et al., both of their experiment showed substantially that the same sets of problems were found with both the low-fidelity prototype and the high-fidelity prototype. But they say that there are several circumstances in which the high-fidelity prototypes are useful, for example: there would probably be set of usability problems for which any particular low-fidelity prototype will be inadequate, such as where physical manipulation is required. According to them, based on their experiences the high-fidelity prototypes are valuable for communication with the: (a) marketing department, (b) developers, and (c) people writing documentation or preparing training manuals.

Although prototyping has been recognized as an efficient and effective means of developing user interfaces for some time, and also has become an integral part of the development process in many organizations, the optimum methods of prototyping have not yet been agreed upon. Rudd, Stern and Isensee (1996) describe in detail the advantages and disadvantages of, and also provide tips for using, both low and high fidelity prototypes. Rudd et al. point out that low fidelity prototypes are often used early in the design cycle to show general conceptual approaches without much investment in development. In contrast, high fidelity prototypes are fully interactive and are used for explorations and tests.

Vaidyanthan, Robbins and Redmiles (1999) describe how HTML can be used to build low fidelity, low cost early prototypes that are iteratively refined into the higher fidelity versions. According to them the low fidelity prototypes are most useful during the early design prototyping phase where a large number of alternatives need to be explored. The HTML prototyping technique uses an iterative approach for the creation of early prototypes. This technique enables the low fidelity prototypes to be iteratively refined into higher versions. As described, this approach enables the designers to use HTML pages to prototype user interface screens and HTML links to represent possible interactions. The prototype is then run in a Web browser for evaluation.

2.1.6.2 Conclusion

Researchers see prototyping as an important tool that involves users in the design process. Prototyping enables users to voice their ideas, thoughts and concerns about a proposed design. This feedback enables designers to design and develop Web sites and Web-based applications that provide a better experience for the users. Various studies by Sefelin et al. (2003), Nielsen (2003c), Grady (2000), and Virizi et al (1996) show that low fidelity paper prototypes are as effective as high fidelity prototypes.

2.1.7 User Interface design guidelines

2.1.7.1 Introduction

By using user interface design guidelines, it is expected that a more usable Web site will be developed. Guidelines can ensure consistency across product functionality, which in turn provides users with a common method for accessing functions and reduces the learning curve for most products. User interface design guidelines should ideally be developed from user study feedback.

The Communication Technologies Branch at the National Cancer Institute has been working to identify research related to Web design and usability, and to translate it into Web design guidelines. Bailey (2003) describes research-based guidelines as the best possible source of information for Web designers about what the relevant research seems to be saying about specific topics for user interface design. He says that greater effort is needed to inform researchers about the issues that practitioners struggle with most in their development of Web sites, and that practitioners need resources to help them ensure that their decisions, whenever possible, are based on research.

Wheeler (2003) says that he as a practitioner believes that the National Cancer Institute's research-based guidelines offer benefits by encouraging an improved user experience through performance-based research. But according to Chaparro (2003), in the field of Web site design, guidelines substantiated by solid research are few and far between. She says that most guidelines result from expert opinion or are carryovers from software design principles established decades ago.

Guidelines help people organize and remember what they already know, and can inspire people to figure out how to do something well. But guidelines are not very helpful in communicating what to do (Rubinstein, 2003). He says that a good standard sets a useful set of constraints that makes the work easier, prevents the need to reinvent the wheel, and puts the focus on achieving goals, rather than on constructing tools. According to Rubinstein, with standards in place, and developers trained to use them, the level of usability will rise, provided the design process uses a user-centred approach.

The difference between patterns, templates, and guidelines is mostly in their approach and attitude. Patterns embody desired behaviour (such as "here is a design that allows users to login") while templates describe a type of page ("here is the login page") and guidelines describe rules to follow ("make sure that labels are either to the left of or above the text entry field") (Spool, 2003a). Spool says that design patterns offer important advantages over traditional templates and guideline approaches, such as: (a) design patterns describe individual design elements whereas templates typically describe an entire page, (b) guidelines are usually short, often not more than a paragraph or two, while patterns are usually multiple pages, going into much more detail, and (c) within the body of the pattern description, the team can talk about why they favour a particular solution.

Beier and Vaughan (2003) highlighted the problems and challenges that were faced at Oracle Corporation to create user interface design guidelines for a family of Web applications, that led them to develop a multi-levelled framework for user interface design guidelines for Oracle's Web applications. According to them, user interface design guidelines tend to provide information that is too general, so they are difficult to apply to a specific case. They say that their multi-levelled framework is unique in that it provides a bridge between two extremes.

Beier and Vaughan dubbed the multi-levelled framework as the 'Bull's-Eye' due to its five layers, represented as concentric circles. The centre of the Bull's Eye is the component layer, followed by page templates, page flows, interface models and patterns, and overarching features and principles. Beier and Vaughan say that in order to support the multi-levelled frame the requirements were gathered from user interface designers, product managers, user interface developers and the product developers. They say that the usability testing of the guidelines occurred on several levels from broad guideline tests to more specific product tests.

According to Spool (2002b), designing a Web site, either usable or unusable, is hard work. He says that there are many details that the designer needs to take into account, such as: (a) browser differences, (b) content management, (c) information architecture, and (d) graphic design. He says that by providing proven guidelines to the developers can reduce their workload, making one aspect of design that much simpler.

Spool says that most interesting is that the guidelines' publishers never present any evidence that following them will actually improve a site. He also adds that not all guidelines are well written, since they are difficult to test to determine if they really will enable designers to produce a more usable site. Spool says that by testing the guidelines, it can be determined which will provide the most value. According to him, following untested guidelines can be possibly harmful.

Instead of using untested guidelines, Spool says that a small investment in studying how users interact with existing sites can reveal a lot about what works for the site users in their tasks. From this an understanding of best practices can be developed, from which guidelines can be developed, which according to him will be far more likely to be of value than generalized guidelines produced from sites that have little or nothing to do with your work.

Chariton and Choi (2002) say that there are many usability problems with travel Web sites. The problems, which they identified in most of the travel Web sites they researched, are as follows: (a) users cannot obtain the same information from the Web site that they could if they used an agent, (b) many Web sites have trouble translating the city name provided by the user into a viable location code for search, (c) the advanced search screen often is not seen by the user, nor are there statements that there is an advanced search screen available for a more detailed search, (d) search results overwhelm the user, and the users have difficulty locating information that would enable them to determine the total cost of travel, and (e) the use of industry-specific terms that are not known to the users is confusing. They suggest new guidelines specific to travel Web sites to counter the above problems that they have identified.

Web-based applications can now be accessed using portable devices such as mobile phones, and PDAs etc. According to Karkkainen and Laarni (2002) the development of small-screen interfaces (e.g. PDAs) and wireless Web access provides challenges for content and interface designers. They say that the style and logic of interfaces may be based on their closest "relatives", and the guidelines connected to those relatives. There are several lists of guidelines for designing Web sites, and even though many of them are based on empirical research, a few of them are quite ad hoc.

Karkkainen and Laarni classify the currently available Web guidelines into three categories according to the aspect of the Web media they are related to: (a) guidelines related to technical aspects of computers and communication, (b) recommendations concerning the content of the Web sites and their organisation, and (c) aesthetics and the layout of Web pages. Based on the characteristics of PDAs, Karkkainen and Laarni provide examples of seven guidelines that may help in designing usable Web sites for small-screen devices.

HCI researchers and designers are involved in developing software tools for learners to support them in mindfully doing and learning complex new work practices. But according to Quintana, Krajcik and Soloway (2002) designers still lack specific scaffolding design guidelines for developing effective scaffolding tools. They suggest that scaffolding guidelines be distilled from an empirical study. They looked at how students used scaffolds and then correlated the student behaviours with the characteristics of the scaffolds, and they were able to formulate some structural guidelines that describe how scaffold characteristics might affect their use.

Quintana et al. have defined scaffolds as software features that support learners in mindfully performing previously inaccessible activities from some work practice without making those activities too automatic to perform. According to them much scaffold software is still developed intuitively, with designers using "educated guesses" and ad-hoc design approaches rather than systematic design methods. They say that that if scaffold tools for learners are to reliably address their different learning and educational goals, then designers need specific methods and guidelines for designing scaffolds that support different aspects of a complex work practice.

According to Ivory, Sinha and Hearst (2001), while there are many usability guidelines designers have historically experienced difficulties following design guidelines. They say that guidelines are often stated at such a high level that it is unclear how to operationalize them. They point out that guideline such as the one that was published by Nielsen in 1999, which claims that the top ten mistakes of Web site design are reasonable and straightforward to implement, are based on subjective observation without any empirical evidence.

Guidelines provide quite helpful and useful tips that enable designers and developers to develop useable interfaces for a system. Vinson (1999) says that unfamiliar, large-scale virtual environments are difficult to navigate. He presents design guidelines for easy navigation in such virtual environments. The guidelines presented focus on the design and placement of landmarks in virtual environments. The guidelines that are suggested by Vinson are based on extensive empirical literature on navigation in the real world. He says that there are three reasons why the navigational design guidelines are needed: (a) many virtual environments require the user to navigate, (b) navigation in virtual environments is difficult and (c) disorientation is upsetting. He says that there is evidence to support that the way we navigate is the same whether the environment is virtual or real. He bases his virtual environment design guidelines on real-world navigation research.

Usability guidelines are becoming increasingly popular with organisations that develop software with significant user interface components. But according to

Henninger, Lu, and Faith (1997), most of the guidelines fall short of the goal to put the accumulated knowledge of user-centred design at the fingertips of everyday developers, often becoming a static document read only by human factors specialists. According to them the usability guidelines should be used as a proactive development resource that can be applied throughout the development process.

According to Rosenweig (1996), design guidelines can help the voice of the customer to be heard and incorporated into the product, and can often shorten development time. She says that guidelines can help ensure that all elements of the product share a common look and feel, including the visual presentation of the data and functions, the organization of information, the behaviour of the graphic objects, and the interaction of the user with the product.

She says that guidelines should never replace thoughtful, well-executed graphical user interface design, prototyping, and usability testing with representative users. An iterative, user-centred approach is still the best way to ensure that a product successfully incorporates the voice of the customer.

The human-computer interface design guidelines are useful for developing usable interface for various kinds of software. Many detailed usability guidelines have been developed for user interface design for Web-based applications, but according to Borges, Morales and Rodriguez (1996) most of the proposed guidelines for Web design are provided without any supporting evidence to show how much the usability will be improved. They say that tests and experiments must be conducted with most of the guidelines to demonstrate that a particular guideline will have a significant effect on the usability of a Web site.

Ogawa and Ueno (1995) had developed approximately 300 human-computer interface design guidelines to assist the design of interfaces of software for network operation. They have also developed a design guideline database, which is named "GuideBook". According to them the "GuideBook" can work as a filter to eliminate bad proposals. According to Ogawa and Ueno, a more productive usage of guidelines is to have one or more designers review an interface design, first via the hypothesis strategy without guidelines, and then via the checklist and hypothesis strategies through the guidelines.

2.1.7.2 Conclusion

The indication is that user interface design guidelines help to improve the usability of Web sites and Web-based applications. However, some researchers such as Rubinstein (2003) and Spool (2003a) argue that guidelines are not very helpful in communicating what to do and are also very brief. Bailey (2003) and Spool (2002b) emphasise the importance of developing guidelines based on research that investigates how users interact with an existing Web site or Web-based application.

2.1.8 Usability Specialist

2.1.8.1 Introduction

Usability specialists ensure that appropriate methods and techniques are adopted and used to design and develop software with a significant focus on usability issues. Usability specialists need to be part of design and development teams if usable Web sites and Web-based applications are to be developed.

According to Nielsen (2002a), a good usability specialist combines observations of multiples users, distils patterns, and arrives at a conceptual insight that can drive the design. He says that the three characteristics that all great usability professionals share are: (a) the knowledge of interaction theory and user-research method methodologies, especially the principles of user testing, (b) high brain power, and (c) ten years of experience running user tests and other usability activities, such as field studies. Nielsen says that only the first of these characteristics can be taught, and much of the usability work requires pattern matching, which is why it is so dependent on brain power and past experience, i.e. once you observe slight traces of a usability issue in users' behaviour, you must deduce the underlying implications.

He says that reaching usability "nirvana" requires many years of experience observing diverse users in varying contexts. He says that it is important to: (a) study a wide range of people, (b) watch those people perform a wide range of tasks, (c) observe them using a wide range of interface designs and styles, and (d) experiment with a wide range of interactions platforms. Nielsen lists two barriers to running a usability study: (a) the fear that you cannot do it, and (b) the desire for perfection.

Tidwell (1999) says that the HCI community should build a human-computer interface pattern language that could help inexperienced designers move away from clumsy designs and labour intensive processes towards a state of confidence and skills, without spending years learning it all the hard way. According to him, a language of this sort is a set of interrelated patterns, which share similar assumptions, terminologies and contexts. He says that such language would aid both individual interface designers in their day-to-day work, and help the whole industry develop better tools and paradigms.

Grudin and Poltrock (1998) say that it is now important that the interface development team become multidisciplinary. According to Grudin and Poltrock there is specialisation within the user interface discipline, particularly in large software development companies that have a wide range of interface concerns. They say that the development of the interface of a product includes designers, developers, human factor engineers, technical writers, education specialists, marketing professionals, linguists, voice and sound specialists, and other professionals. According to them the biggest challenge in designing an interface in a large organization is managing the communication amongst the people involved in interface development. Grudin and Poltrock say that the user interface design process within organizations needs to be better understood.

Grudin and Poltrock carried out a survey to address the multidisciplinary and collaborative nature of user interface design as it is practiced in a large software development organization today. Their result indicates that communication could be improved through the development of appropriate tools, through organisational change, or through a combination of the two. According to them the existing problems that the study points to are the relative isolation of training development from other aspects of user interface design, and an overall lack of management understanding and support for human factors.

According to Karat and Dayton (1995), for usability specialists a broad range of mostly social, organisational and artefact-design skills are important for interface design. Most important to them is practical experience in activities of usability engineering. Karat and Dayton strongly believe that highly skilled people are needed for interface design. According to them, careful design and informal evaluation, rather than casual design and formal evaluation, are the keys to producing good interfaces in the real world of industrial software development.

Howard (1995) developed a checklist of things that a user interface designer needs to know, based on number of publicised curricula in HCI. He used the checklist as a basis to conduct a series of structured interviews with practising user interface designers. He found out that whilst knowledge of some aspects of published curricula was considered vital to the practice of interface design, knowledge of other components such as the psychological foundations of users is also required. He raises issues that are critical to the development of appropriate HCI curricula, such as: (a) what is the nature and form of the HCI discipline, (b) how can HCI affect changes to extend the world's understanding of
HCI practices, and (c) knowing the educational process that guides the structure of HCI courses.

According to Myers (1994), the developers designing user interfaces should involve trained user interface specialists, since they have been proven to significantly improve interfaces and have been cost effective. Myers says that while it is important to follow any guidelines that are relevant, this is not sufficient to ensure high quality. He says that iterative design is vital to the creation of good user interfaces, although it cannot replace having good designers. According to him general usability engineering methods should be followed, especially since there are some simple "discount" methods that are often sufficient. Myers says that it is very important that user interface design be part of a programmer's education since programmers need to understand that HCI design is a valued field where special training is required to create high quality user interfaces.

2.1.8.2 Conclusion

Researchers such as Nielsen (2002a), Karat & Dayton (1995), Howard (1995), and Myers (1994) emphasise that the education, skills, training and experience of usability specialists help design teams to design and develop Web sites and Web-based applications with usability in mind.

2.1.9 Usability Evaluation

2.1.9.1 Introduction

It is very important that usability issues for Web sites and Web-based applications are thoroughly dealt with before they are released, if they are to have an impact. Usability evaluation should always be part of the design and development process of Web sites and Web-based applications. The likely usability problems can only be identified if usability evaluation is carried out at all stages of the design and development process, with the involvement of the target audiences

One answer to the question of how to get the clients to pay for the usability is to include it in the overall price rather than to charge for usability as extra (Nielsen, 2003a). According to Nielsen it is impossible to design the perfect user interface on the first try, and according to him even the world's best designer cannot immediately produce an interface that is perfectly simple, meets all users' needs, and never induces a user error. In design, usability serves the same role as debugging, building codes, or editing serves in other fields. He says that a design will have weaknesses, and usability provides principles and testing methodologies to find those weaknesses in order to improve the user interface.

"The reason usability is not opposed to fun is that the greatest joy of using computers comes through user empowerment and engagement" (Nielsen, 2002a). He says that a user's personal experience trumps anything the designer is trying to communicate. According to Nielsen, if users cannot master the interface, they will feel oppressed rather than empowered, and are unlikely to explore or use anything beyond the absolute minimum.

According to Nielsen, most studies rely on classic and not completely satisfactory ways of assessing user enjoyment: (a) a subjective satisfaction questionnaire administered at the end of a study, and (b) observations of the user's body language for indications of satisfaction or displeasure (smiles or frowns), as well as laughs, grunts, or explicit statements such as "cool" or "boring". Nielsen suggests that we need better methods for testing enjoyable aspects of user interfaces, methods that should be both robust and easy to apply, since people with relatively little expertise do the vast majority of user testing in the user interface development world.

According to Nielsen (2001) usability can be measured, but it rarely is. Nielsen provides two reasons why usability is rarely measured, which are: (a) metrics are expensive, and (b) metrics are a poor use of typically scarce usability resources. Nielsen says that usability metrics: (a) track progress between releases, (b) assess a company's competitive position, (c) make a stop or go decision before launch, and (d) create bonus plans for design managers and higher-level executives. He says that measuring usability can cost four times as much as conducting qualitative studies, and testing involves more than five and up to twenty users for each design in order to collect the usability metrics.

One way to help ensure a proper user-centred design is thorough effective and efficient usability testing. Harrison and Mancey (1998) did a study to find out the optimal amount of time for obtaining accurate usability-test results. Their study focused on varying the elapsed time before gathering a user's reaction to the designs. Their results revealed that: (a) the length of time the user spends working with a design did affect the user's evaluation, but the evaluations tend to stabilize after working for about fifteen consecutive minutes with an interface design, (b) the frequency in which a user was asked to evaluate a design did not significantly affect the user's evaluation of the design, (c) the order in which a user was presented particular interfaces did not affect the user's preference for a particular type of interface, and (d) the users preferred the frame-like design to the paper-like design of online manuals, but more questions were accurately answered using the paper-like design.

Keevil (1998) defines usability as how easy it is to find, understand, and use information displayed on a Web site. He discusses the development of a checklist that can be used to measure the usability of a Web site. He developed this checklist based on models of other checklists such as Raven's human-computer interface checklist, and the checklist developed by Chignel and Keevil to calculate a usability index. His checklist uses the question and answer method because he believes: (a) that it more accurately tracks continuous enhancements to a site, and (b) it is also more consistent when only one evaluator tests a Web site at different times in the development life cycle.

Lim and Usama's (1998) case study results point out that care must be taken when interpreting subjective results of a summative evaluation of a system that has already been implemented. They found out that subjects tend to be culturally positively biased towards a system that has been essentially completed or implemented, and the results of subjective evaluation poorly correlated with objective performance. According to Lim and Usama, subjective assessment can be useful for determining underlying reasons for a particular user attitude towards a particular cause.

Herman (1996) also suggests that cultural factors may significantly affect the correlation between subjective and objective evaluation. She says that without adequate understanding of cultural factors, appropriate decisions cannot be made on the type of usability evaluation to take. In her study the results of subjective evaluation poorly correlated with objective evaluation. She found out that the results of subjective evaluation tended to be positive despite poor user performances.

According to Karat and Dayton (1995) in most cases of design and development of commercial software, usability is not dealt with at the same level as other aspects of software engineering. According to them, clear usability objectives are not set and the resources for appropriate activities are not given priority by project management. The result is the assignment of responsibility for usability to people who do not have appropriate training.

In order to get usability methods used more in real development projects, the usability methods must be made easier to use and more attractive (Nielsen, 1995). He says that one way of doing so is to consider the way current usability methods are being used and what causes some methods to be used and others to remain a good idea, which might be used on the next project. According to Nielsen it is equally important to make the methods cheaper and faster to use and to create the impression that the methods are easy to learn, and if used correctly will definitely help to identify usability problems.

According to Nielsen (1994), the simpler methods stand a much better chance of actually being used in practical design situations, and they should therefore be viewed as a way of serving the user community. Nielsen proposes the discount usability engineering method, which is based on the use of three techniques: (a) scenarios, (b) simplified thinking aloud, and (c) heuristic evaluation.

Human factors practitioners currently rely on two types of techniques to evaluate representations of user interfaces: (a) empirical usability testing in laboratory or field settings, and (b) a variety of usability walkthrough methods (Karat, Campbell & Fiegel, 1992). They say that there are substantial differences between the various usability walkthrough methods, that are referred to as: (a) pluralistic walkthroughs, (b) heuristic evaluations, (c) cognitive walkthroughs, (d) think-aloud evaluations, (e) scenario-based reviews, and (f) guideline-based reviews.

Karat at el. (1992) investigated the relative effectiveness of empirical usability testing and individual and team walkthrough methods in identifying usability problems in two graphical user interface systems. They found out that empirical testing detected the largest number of usability problems, and also identified a significant number of relatively severe problems that were missed by the walkthrough conditions. They also found that team walkthroughs achieved better results than individual walkthroughs in some areas. According to them the cost-effectiveness data shows that empirical testing requires the same or less time to identify each problem compared to walkthroughs.

According to Sullivan (1991), a multiple methods approach for usability evaluation of interfaces is helpful. She says that a multiple methods approach gives the designers a strategy that makes sense to the researchers in other areas at the same time as it allows them to design studies that answer the questions applicable to the project. She used focus groups with laboratory observation for her study and found out that both techniques provided diverse input on key user interface issues such as: (a) look and feel, (b) accessibility, and (c) intuitiveness. She also mentions that there may not be an ideal pairing of methods for all situations, as responses to a combination of how and why questions that explore the possible features of an emerging interface, but the pairing can add interesting complementary information.

One important reason why usability engineering is not used in practice is the cost of using the usability techniques. But according to Nielsen (2003b) even with a budget of two hundred dollars, designers can perform usability evaluation. Usability methods are incredibly flexible and scale up or down according to circumstances. Nielsen says that on average, best practices call for spending ten percent of a design budget on usability.

Mantei and Teorey (1988) reported that the cost required for ensuring usability for software projects was $US128,330.00. A report by Bellotti (1988) states that a British study for usability reveals that many developers do not use usability engineering because HCI methods are seen as too time consuming and expensive, while the usability evaluation techniques are often intimidating.

The usability budget for software development is slowly increasing. According to Shackel (1971) the usability budgets for non-military systems was about three percent. A study by Wasserman (1989) of several corporations found that many organizations allocated between four to six percent of their budget to usability work. A study done by Nielsen (1993) found out that organizations allocated six percent of their budget for usability work.

2.1.9.2 Conclusion

Many researchers in the area of user interface design have identified cost as the main reason why many design teams do not conduct usability evaluations. Nielsen (1995) strongly feels that evaluation methods must be made easier to use. Studies done by Shackel (1971), Wasserman (1989), and Nielsen (1993) show that usability budgets have increased from three percent in 1971 to six percent in 1993. Karat, Campbell & Fiegel (1992) suggests ideal situations for using usability testing in laboratory or field settings, and when to use usability walkthrough methods.

2.1.10 Evaluator Effect

2.1.10.1 Introduction

There has been debate amongst practitioners regarding the number of evaluators needed to identify likely usability problems. Some argue that five users would identify almost eighty percent of usability problems while others say that it requires eight users to do the job. Evaluation data can only be relied upon to fix all the usability problems of Web sites and Web-based applications if all the evaluators are able to identify similar problems, and at the same time are also able to identify most of the usability problems regardless of the evaluation method used.

Schroeder (2003) says that there are many usability handbooks and guidelines offering good advice, but a good question is whether developers should adopt it without seeing it in action. He draws attention to the study done by Rolf Molich, which describes in great detail the work of different usability teams that independently tested the same interface. The study was set up in such a way that all the teams were given the same test scenarios and objectives for the same interface. Each team then conducted a study using their organization's standard procedures and techniques, and complied reports that were sent to Rolf Molich. While Rolf found that a wealth of usability problems were identified in the interface, there was not a single problem that every team reported, and surprisingly eight of the nine teams missed seventy-five percent of the usability problems.

Hertzum, Jacobsen and Molich (2002) say that the evaluator effect is a major threat to the reliability of usability inspections. They state that the first thing to do to cope with the evaluator effect is to acknowledge its existence. They did a study with eleven usability specialists who individually inspected a Web site and found out that the overlap in the reported problems between any two evaluators averages nine percent.

They state that the eleven usability specialists who were used in the study were largely in agreement on the different problems that they had identified, and perceived the dissimilar observations as multiple sources of evidence in support of the same issues, not as disagreements. According to Hertzum et al. the group work increased the evaluators' confidence in their individual inspections, rather than alerted them to the evaluator effect.

A study done by Jacobsen, Hertzum and John (1998) on the evaluator effect in usability tests found out that only twenty percent of the ninety-three errors and faults were detected by all of four evaluators who were used in the study, and only forty-one percent of all the severe problems were detected by the four evaluators. According to them the results of their study were not surprising, but are certainly overlooked in the field of usability testing. They say that the evaluator effect puts usability testing in perspective, and questions the use of data from usability tests as a baseline for comparison to other usability evaluation methods.

2.1.10.2 Conclusion

Studies by Schroeder (2003), Hertzum et al. (2002) and Jacobsen et al. (1998) show that given the same interface, different evaluators produce different usability results. This is called the evaluator effect. Design teams need to be aware of the evaluator effect so that they can pay serious attention when interpreting evaluation results. Evaluation methods and practices for usability have to be improved so that different evaluators will consistently find the same problems.

2.1.11 Usability labs

2.1.11.1 Introduction

Usability labs play an important role in conducting various rounds of usability tests with the users of Web sites and Web-based applications. However, setting up a usability lab has always been regarded as a costly affair. Regardless of this drawback, they enable design teams to observe how users interact with the Web site or Web-based application in an environment that they are familiar with.

According to Waterson, Landay and Mathews (2002), while usability testing in labs is expensive and time consuming, it provides good qualitative feedback. In their paper they discuss a usability study regarding wireless Internet-enabled personal digital assistants. They compare usability data gathered from lab testing with data gathered by a proxy-based clickstream logging and analysis tool. They conclude that while clickstream and remote testing seem to be pretty good at finding usability issues relating to the Web content displayed on the mobile device, they are a poor substitute for finding the usability issues with the device itself. According to them, lab testing provides qualitative information, such as spoken comments.

Madsen (1999) says that US software development companies have a long history of having usability labs whereas with Scandinavian countries, usability labs are a fairly novel experience. According to Madsen, from the 1990s Denmark has seen the emergence of usability labs, which has enforced and institutionalised usability. On the other hand, Madsen says that Scandinavian countries have a strong tradition of involving users informally, which has influenced the US industry where user-centred approaches are becoming more popular.

Without regular sessions in the usability lab during the development cycle, projects are guaranteed to head in directions that do not benefit the users of the product (Berkun, 1999). According to him the value of usability labs goes beyond the important usability data that is obtained, and he adds that usability testing provides significant payback only when it is well integrated into the entire project lifecycle. He says that the value comes from doing regular tests, starting with early prototypes, and repeating trips to the lab at regular intervals as the design and product develop.

According to Kantner and Rosenbaum (1997), three things have to be considered to assess the usability of Web sites: (a) the purpose of the Web site, (b) profiles of its intended users, and (c) typical scenarios of the Web site. They compared heuristic evaluation with laboratory testing. They strongly emphasise that the results of heuristic evaluation are not the actual user data, and thus are slightly suspect since heuristic evaluation is carried by evaluators, whereas real users are used for laboratory testing. While laboratory tests can explore questions with measurable answers, to confirm or challenge the assumptions of developers, it is a significantly costly technique to evaluate the user interface of a Web site.

In recent years, many organizations have set up usability laboratories to carry out software evaluation, but user evaluation in a developer's laboratory will not necessarily provide the same information as an evaluation carried out in context, which is at the user's desk in their workplace or at home (Noyes & Harriman, 1995). Noyes and Harriman argue that software products should also be evaluated by the end-users after they have been released. They say that post-release evaluations are the most accurate appraisals of usability, since the actual user, product, and environment are all in place and interacting with each other. This data would enable designers to develop more usable products in the future.

They point out that even in the mid-1990s user involvement was still comparatively rare in the final stages of a product's life cycle. Noyes & Harriman strongly emphasise that active evaluation after product release should not replace either preceding user involvement in early stages of development or existing passive evaluation by end-users. Rather, it should be viewed as an additional activity.

Usability testing is not always best accomplished within the confines of a specially equipped usability laboratory (Rowley, 1994). He says that the overhead involved in maintaining a dedicated usability test lab can be prohibitive, and the cost and planning required to rent a facility can make routine use an unrealistic option. He describes a mobile usability testing program, which according to him can provide a low cost alternative to a dedicated usability lab. He says that field usability testing allows a development team to collect this valuable data from a widely distributed customer base. According to him, the field usability testing lab communicates to users a sense of genuine respect for their concerns, and allows users to have a say in product development.

Sullivan (1991) describes the usefulness of combining focus groups with laboratory observation, which she says enables data to be gathered as richly as possible. According to her they provide diverse input on key interface issues such as: (a) look and feel, (b) accessibility, and (c) intuitiveness. Sullivan says that even though it may not be the ideal pairing of methods for all situations, as responses to a combination of how and why questions that explores the possible features of an emerging interface, this pairing can add interesting complementary information.

A core group of elite corporate research labs and a few universities defined the field of HCI and established much of whatever ease of use we now enjoy (Nielsen, 2002c). According to Nielsen, even though good HCI research occurs at hundreds of worldwide locations, only a few research labs have defined the field and nurtured the most important work. Nielsen lists: (a) the Stanford Research Institute, Xerox PARC, and Bell Laboratories as the leading usability labs from 1945 to 1979: (b) Xerox PARC, the IBM T.J. Watson Research Centre, and the MIT Media Lab as the leading usability research labs for 1980s, and (c) Bell Communications Research, the Apple Computer Advanced Technology Group, and Xerox PARC as the leading usability research labs for 1990s. Nielsen says that the big usability research labs are disappearing and the future of HCI research is in jeopardy.

Melkus (1985) states that with IBM, usability has been incorporated into the development cycle of applications. He says that IBM has a usability lab that has not only improved the usability of its software products, but has also helped facilitate both the inclusion of usability considerations throughout the development process and the amplification of human factors awareness in the organization. Melkus describes several other benefits of having usability labs: (a) the capability of using multiple observers, (b) having a controlled environment, (c) having the provision of a neutral observation point, (d) the preservation of data, (e) the ability to observe the total system, and (f) a newly acquired understanding of the users at work.

According to Melkus, while laboratory testing for usability has its drawbacks, it accomplishes: (a) its major goal of improving the quality of software products, (b) a contribution to future products, and (c) raising the level of human factors awareness within an organization.

2.1.11.2 Conclusion

Various studies show that usability labs enforce usability within organizations. A study done by Madsen (1999) shows that Denmark has seen the emergence of usability labs, which has enforced and institutionalised usability in that country. Studies by researchers in this area highlight the importance of usability testing in labs, whereas researchers such as Noyes & Harriman (1995) and Rowley (1994) argue that designers and developers should focus on post-release testing with users and field studies to identity and fix usability problems.

2.1.12 Heuristic Evaluation

2.1.12 Introduction

Heuristic evaluation is regarded as an easy to learn and use method for evaluating a user interface. Knowing the limitations of this method is important so that the design team can know for which design projects it is most appropriate to use this method to identify likely usability problems.

Agarwal and Venkatesh (2002) employed Microsoft's usability guidelines as heuristic guidelines to assess Web site usability of various industries: (a) airline, (b) bookstore, (c) auto manufacture, and (d) car rental. According to them their findings suggest that the heuristic evaluation method provides detailed insights into potential design defects. They say that two key implications that emerge from their study are: (a) to extend usability as an important metric for assessing Web site design, managers need systematic methodologies for performing usability assessments, and (b) their results shed light on what factors need attention to improve usability.

Burton and Johnston (1998) used Nielsen's heuristic guidelines to identify the usability problems of NEST (The Networked Assessment ToolKit) that allows production, delivery, and assessment of Web-based examinations and surveys at the University of Melbourne. They used students, the main users of NEST, as evaluators, and the students identified several usability problems. Burton and Johnston conclude that their usability studies indicate that testing is likely to highlight additional problems.

Muller, Matheson, Page, and Gallup (1998) present Participatory Heuristic Evaluation, which has been derived from Nielsen's heuristic evaluation. They say that the Participatory Heuristic Evaluation technique extends the heuristic evaluation in two ways: (a) it adds new areas of concern to the list of heuristics used to guide inspectors under heuristics evaluation, and (b) it also adds users who are work domain experts to the list of expert inspectors under heuristic evaluation.

Muller et al. emphasise that Participatory Heuristic Evaluation is approximately as easy to conduct as heuristic evaluation, and if workers are nearby, it is also inexpensive to perform compared to heuristic evaluation. They also point out that Participatory Heuristic Evaluation does not replace participatory design or usability testing, but it can help to guide iterative designs or iterative prototypes from one point to another.

According to Jacobsen, Hertzum and John (1998), using the heuristic evaluation method to find problems does not seem to be too difficult – however rating the severity of each problem is a major problem.

With regard to Web usability evaluation, heuristic evaluation and laboratory testing are the two most frequently used approaches (Kantner & Rosenbaum, 1997). Heuristics evaluations are assessments conducted by a small group of evaluators against a pre-established set of guidelines.

Jeffries, Miller, Wharton and Uyeda (1991) conducted a study to find the effectiveness of four usability evaluation techniques, which were: (a) heuristic evaluation, (b) usability testing, (c) cognitive walkthrough, and (d) guidelines. Their results show that for software engineers to identify some important usability problems, when user interface specialists are not available, they can use the guidelines and cognitive walkthroughs. Jeffries et al. (1991) found out that heuristic evaluation and usability testing have an advantage over the guidelines and cognitive walkthrough since heuristic evaluation and usability testing help to find severe problems that could not be identified by guidelines or cognitive walkthroughs.

They say that the heuristic evaluation technique runs the risk of finding several problems, some of which may not be the most important to correct. They emphasise that careful consideration of: (a) the goals of the evaluation, (b) the kinds of insights sought, and (c) the resources available, must be considered before deciding on which method to use from the four that they had used for their study. According to Jeffries et al. heuristic evaluation and usability testing draw much of their strength from the skilled user interface professionals who use them.

Heuristic evaluation is done by looking at an interface and trying to come up with an opinion about what is good and bad about the interface (Nielsen & Molich, 1990). They say that people could conduct such evaluations according to certain rules, such as those listed in typical guidelines documents, or people could perform heuristic evaluation on the basis of their own intuition and common sense. The results of their study showed that one should not rely on the results of having a single person look at an interface.

According to Nielsen and Molich the results of heuristic evaluation will be much better if the designers have several people to conduct the evaluation and this is done independently. They emphasise that: (a) the heuristic evaluation is to be done by three to five evaluators, and (b) any additional resources are spent on alternative methods of evaluation.

2.1.12.2 Conclusion

While various studies show that heuristic evaluation highlights detailed insights into potential usability problems, a study by Jacobsen, Hertzum and John (1998) suggests that rating the severity of each problem is a major problem. Heuristic evaluation and usability testing were identified by Jeffries et al. (1991) as more useful than guidelines or cognitive walkthroughs because heuristic evaluation and usability testing helped to find severe problems that could not be identified by guidelines or cognitive walkthroughs.

2.1.13 GOMS (Goals, Operations, Methods, and Selection)

2.1.13.1 Introduction

The GOMS method of evaluation can provide useful usability information where user testing is not possible. There are four different GOMS analysis techniques: (a) KLM (Keystroke-Level Model), (b) CMN-GOMS (Card, Morgan, and Newell- Goals, Operations, Methods, and Selection), (c) NGOMSL (Natural GOMS Language), and (d) CPM-GOMS (Cognitive-Perceptual-Motor

GOMS). These four GOMS methods of evaluation are not regarded as easy to learn or use.

Ritter and Young (2000) describe how cognitive models are useful to the field of HCI by: (a) predicting task times, (b) assisting users, and (c) acting as surrogate users. The model human processor, the keystroke level model, and the GOMS Family of techniques have all been successfully deployed in the laboratory and in industry. They say that the models: (a) can be used to modify interactions to help the users with their tasks, (b) are very useful for populating synthetic environments, and (c) in the future will also lead to new models that can test interfaces by behaving like a user. However, they highlight one major limitation of the cognitive model, which is the difficulty in connecting the cognitive models to their task environment when the connection or the interface has to be built, and sometimes both at once.

Since the publication of the Psychology of HCI, the GOMS model has been one of the most widely known theoretical concepts in HCI (John and Kieras, 1996a). John and Kieras compare and contrast four GOMS analysis techniques, which are: (a) KLM (Keystroke-Level Model), (b) CMN-GOMS (Card, Morgan, and Newell- Goals, Operations, Methods, and Selection), (c) NGOMSL (Natural GOMS Language), and (d) CPM-GOMS (Cognitive-Perceptual-Motor GOMS). According to them the strengths and weaknesses of each technique correspond quite directly to its structure. They say that the four specific GOMS techniques are all related to a general task-analysis approach, which emphasises the importance of the procedures for accomplishing goals that a user must learn and follow in order to perform well with the system.

The overall motivation for GOMS and other HCI cognitive modelling efforts is to provide engineering models of human performance. Such models produce a priori quantitative predictions of performance at an earlier stage in the development process than prototyping and user testing (John and Kieras, 1996b). According to them the GOMS models are used to predict execution time, leaning time, and errors, and to identify those parts of the interface that lead to these predictions. They say that the theoretical foundations of the models allow the designer to choose the right model for the required level of detail in the design problems and to recognize when the design problems involve issues and factors that are not addressed by the models.

John and Kieras provide detailed descriptions of various techniques of the GOMS model and when each different technique of the GOMS model would be useful. They emphasise that the GOMS models: (a) make priori predictions, (b) cover a range of behaviour involved in many HCI tasks, and (c) have been proven to be learnable and usable for computer designers.

GOMS is a method for describing a task and the user's knowledge of how to perform the task in terms of goals, operators, methods, and selection rules (John, 1995). He also says that GOMS analysis produces quantitative and qualitative predictions of how people will use a proposed system. The prediction allows designers to: (a) evaluate alternative systems before buying one, (b) evaluate rival design ideas at the specification stage of design, (c) focus design efforts on those parts of a system that will cause users the most problems, and suggest a better design, (d) determine execution times of tasks that skilled users are likely to perform, (e) determine how long it will take to learn to perform a task, (f) determine the frequency of errors that might be made due to forgetting, and (g) calculate the human costs in the system.
John provides situations when the GOMS model may not be useful, such as: (a) when the system that is being designed would only be used by novice users, (b) when designing a system that does not have any predecessor since designers may not know why or how people will ultimately use it, and (c) when designing a leading edge technology system where operators are not yet well-understood, like gesture-recognition or some forms of virtual reality, since the learning and performance will be new.

Gong and Kieras (1994) describe how a GOMS model was used to design and evaluate the user interface for a specialized CAD program for the field of industrial ergonomics. The application known as Three Dimensional Static

Strength Prediction Program had been commercially available for DOS computers through the University of Michigan for three years.

The design problem of interest was to create a Macintosh version of the software. Their purpose was to demonstrate that a formal GOMS model approach could indeed provide useful design guidance for a realistic design problem. According to them the redesign of the interface based on the GOMS approach resulted in a forty-six percent reduction in learning time and thirty-nine percent reductions in execution time during a formal evaluation. They strongly emphasise that designers should consider using the GOMS model approach when circumstances prevent a full empirical evaluation.

2.1.13.2 Conclusion

Researchers point out that the GOMS method of evaluation is not suited for applications which would be mostly used by novice users. The GOMS model is best viewed as reducing the amount of user testing required to develop a highly usable application. The GOMS method of evaluation is used by designers themselves to evaluate how an application would be used. The GOMS method of evaluation is best suited if a prediction of skilled behavior is required.

2.1.14 Cognitive walkthrough

2.1.14.1 Introduction

Cognitive walkthrough is another evaluation method that is regarded as easy to learn and use to evaluate design ideas for Web sites and Web-based applications. This technique enables users to evaluate a design idea by performing a given task. The user is closely observed while performing the task, without any interference, to identify any problems that the user may encounter.

Blackmon, Polson, Kitajima and Lewis (2002) present a new Cognitive Walkthrough for the Web (CWW) for use in the design and usability evaluation of Web sites. The CWW is a theoretically based usability inspection method that can be applied at all stages of the design and development process. It simulates users performing navigation tasks on a Web site by assuming that users perform goal-driven exploration.

To speed the evaluation process and to reduce the need for formal training in cognitive psychology, the cognitive walkthrough process was revised to incorporate detailed step-by-step task descriptions. Sears and Hess (1998) did a study of this change to cognitive walkthrough. They found out that providing a detailed step-by-step task description significantly changes the types of problems found.

John and Packer (1995) say that there has been growing interest in studying different usability evaluation techniques to understand their effectiveness, applicability, learnability, and usability. According to John and Packer, researchers developing techniques need to have feedback to allow them to improve and expand the techniques in useful directions. They say that experiments have been done to compare performance outcomes of different techniques.

John and Packer conducted a study in which they used five volunteer system designers who had no knowledge of HCI to evaluate user interface specifications of an ACSE multimedia authoring system using evaluation techniques of their choice. According to John and Packer, cognitive walkthrough was one of the evaluation techniques used by one of the volunteers. They had John Rieman, the developer of the cognitive walkthrough evaluation technique, examine this volunteer's work in detail, which he rated as fairly good, though with some flaws.

John and Packer emphasise that the cognitive walkthrough evaluation technique is learnable and usable for a computer designer with little psychological or HCI training. One major difficultly that they point out that may be faced by the users of cognitive walkthrough is that it does not give guidance about how to pick the task scenarios that are used to test the interface design.

In contrast to other types of usability evaluations, the cognitive walkthrough focuses on a user's cognitive activities, specifically the goals and knowledge of a user while performing a specific task (Wharton, Bradford and Franzke, 1992). While it is based on exploratory learning, their study reveals that there are many variables that can affect the success of the technique. The problems they point out with cognitive models are related to process mechanics, and other limitations of the model such as not matching well with current software development practice. In their view cognitive models require substantial extensions through research, and practical use in industrial settings has to wait for these extensions.

Rowley and Rhoades (1992) propose a new evaluation technique called jogthrough based on cognitive walkthrough. Since the structured walkthrough technique is time-consuming when used on substantial tasks, according to them this fast paced methodology is well suited to product development environments where multidisciplinary teams evaluate proposed interfaces. According to Rowley and Rhoades, jogthrough is informal, and the fast-paced feel of evaluation encourages participants to make design suggestions and provides a theory-based framework that can be used to immediately screen the design suggestions. By allowing design alternatives to be proposed and discussed during the evaluation session, the jogthrough procedure becomes a technique that could be used for collaborative design.

Cognitive walkthrough gives designers the ability to find out likely usability problems before designing the interface, without empirically testing the prototype with the users. Because it gives insight into the cause of usability problems as well as their point of occurrence, designers can use the results to make precise improvements to their design (Rieman, Davies, Hair, Esemplare, Polson and Lewis, 1991).

According to Rieman et al. the early versions of walkthrough suffered from tedious and repetitious paperwork. They propose an automated system that has several advantages over a paper walkthrough that bypasses irrelevant questions and helps the analysts to maintain a dynamic list of a hypothetical user's goals. They say that the analysts are able to use the tool with about an hour's training.

The usefulness of the cognitive walkthrough method of evaluation is also accentuated by Lewis, Polson, Wharton and Rieman (1990), who used theory of exploratory learning (cognitive walkthrough) to generate a list of theoretically motivated questions about the user interface of an advanced phone service that was intended for use with minimal formal training requirements. Their results showed that the cognitive walkthrough methodology detected almost fifty percent of problems that were revealed by full-scale evaluation.

Lewis et al. state that walkthrough with a very limited investment in resources – approximately an hour per task per interface – can detect almost 50 percent of problems that would be encountered by users. According to them the successful transfer of walkthrough methodology to another group would require the development of suitable training programs in underlying theoretical models, including practice exercises to shape the intuition necessary to successfully apply the theory in the walkthrough.

2.1.14.2 Conclusion

Various studies show that cognitive walkthrough is a useful evaluation technique that enables designers to identify likely usability problems with their design ideas. Rowley and Rhodes (1992) created a faster version of cognitive walkthrough which they named "jogthrough". While John and Packer (1995) point out that the cognitive walkthrough evaluation technique is learnable and usable with little psychological or HCI training, it does not give guidance about how to pick the task scenarios that are used to test the interface design.

2.1.15 Expert Review

2.1.15.1 Introduction

Expert review is an evaluation technique where an expert goes through the Web site or Web-based application to identify likely usability problems. This method of evaluation does not involve users for evaluation and suits those projects that have a limited time frame for development.

An expert review is strictly a diagnostic tool, which means that it is not intended to substitute for data gathering, usability testing, or a well-informed redesign process (Yee, 2002). According to Yee, expert review can be used: (a) during the evaluating phase of a redesign project, (b) in early design or development phases for a new prototype or release, (c) when planning and preparing for a major usability test, or (d) for post-release evaluation.According to Sawyer, Flanders and Wixon (1996) at Digital Cooperation, user testing and usability inspection are used to identify different usability problems with their product. They say that for those clients who are short of time and budget, and value an expert opinion, they suggest inspections since they take less time. But according to them, user-testing suits those clients who have a little more time and budget and do not value expert opinions. They say that while it is important for usability professionals to find usability problems quickly and effectively, it is equally important to have an impact on the usability of products examined and to reflect on the effectiveness of usability practice.

Savage (1996) compared the results of three different user interface evaluation techniques; (a) expert reviews, (b) user reviews, and (c) interactive usability testing. She found out that user reviews resulted in significantly more redesign of user interfaces but required most effort, and was expensive to conduct. According to her, expert review feedback tends to identify areas that require further user testing.

2.1.15.2 Conclusion

Expert review alone can not be relied upon to identify all likely usability problems, as suggested by Yee (2002) and Sawyer et al. (1996). Savage (1996) asserts that further usability tests are required for usability problems identified through expert review.

2.1.16 Computer Assisted Evaluation of Interface Designs

2.1.16.1 Introduction

Computer assisted evaluation enables a fast evaluation of user interfaces, while being less subjective to human error and less affected by the skill of the evaluator.

According to Chi et al. (2003), years of development in HCI theory seems not to have prepared developers for an answer to how Web sites should be designed. They say that it has resulted in ad-hoc methods being used for designing Web site navigation and content structure. Chi et al. describe a prototype of an automated usability tool called infoScent Bloodhound Simulator, a push-button navigation analysis system that automatically analyses the information cues on a Web site to produce a usability report. They say that: (a) the report specifies the probability of success for each individual task, and (b) by employing Web agents to discover usability problems it dramatically reduces the cost of searching and fixing Web site navigation problems.

Automated support for the capture, representation, and empirical analysis of user behaviour is leading to new ways to evaluate usability and validate theories of HCI (Laskowski, Landy and Lister, 2002). According to Laskowski et al. automation enables: (a) remote testing, (b) testing with larger numbers of subjects, and (c) the development of tools for in-depth analysis.

Various studies show that usability findings can vary widely when different evaluators study the same user interface, even if they use the same evaluation technique. This result implies a lack of systematicity or predictability in the findings of usability evaluations (Ivory and Hearst, 2001). They firmly believe automation will enable systematicity and more complete coverage in usability assessment. And according to Ivory, Sinha and Hearst (2001), on average "automated evaluations" can accurately identify about sixty-seven percent of the good pages versus the "not-good" Web pages.

Research in HCI has resulted in the emergence of analytical models that allow the developers to evaluate the interface design on paper before the actual prototype is built (Khalifa, 1998). But Khalifa says that this is not widely practiced since the models are too complex to be used. He proposes a computer system to remove this obstacle. According to Khalifa the system enables interface designers to describe an interface design formally, and then assess it in terms of usability dimensions such as ease of learning and ease of use. He says that it facilitates and structures task analysis, and lets designers avoid the burden of learning the complex syntax of analytical models.

Balbo, Coutaz and Salber (1993) present an analysis of an automatic evaluation of multimodal user interfaces. They designed a generic Wizard of OZ platform that allows observation and recoding of a subject's behaviour while interacting with a multimodal interface. According to them the recorded data is then analysed to reveal the likely usability problems.

2.1.16.2 Conclusion

Various studies suggest that the use of automatic tools to evaluate Web sites and Web-based applications for usability will save a considerable amount of development time and will also remove the burden from designers of learning various evaluation methods. They will also help to remove the evaluator effect and produce consistent usability test results that can be relied upon to fix any usability problems.

2.1.17 Discounted methods for evaluation (heuristic evaluation, cognitive walkthrough, think aloud technique)

2.1.17.1 Introduction

Discount methods for evaluation help designers to quickly evaluate a Web site or Web-based application to identify usability problems. These methods are cheap, simple, and easy to learn and use, which enable designers to perform usability evaluation rather then putting the application in use without any usability evaluation.

Discount methods have the appeal of seeming easy to do, and being inexpensive but discount usability methods may be too risky to justify the "low" cost (Cockton and Woolrych, 2002). They say that their research in discount methods indicates that discount methods may be so error-prone that they discredit usability practitioners and should not be used in HCI. Cockton and Woolrych say that inspection methods and discount user testing: (a) do not encourage analysts to take a rich or comprehensive view of interaction, (b) restricts the range of user capabilities, knowledge and tasks sampled, and (c) fails to expose test users to the system features that are most likely to result in unsatisfactory interaction.

According to Cockton and Woolrych: (a) there will always be a place for discount methods, (b) there is a need to improve all HCI methods, so that discounted methods are less discounted and "full strength" methods can be applied in more contexts, (c) although discount methods are most appropriate to drive design iteration, in most cases a little more planning, better analysts, more users and more analysis will all pay off, and (d) in real contexts, impact comes not from usability experts generating solution recommendations in isolation, but from working together with multidisciplinary project teams to generate solutions.

There is considerable need for improvement in overall usability testing and evaluation (Bailey, 2002). He says that effective usability testing and evaluation is extremely difficult to do well. According to him, fewer discount methods are needed and he firmly believes that more research-based valid methods are needed to find true usability problems.

Evaluating application designs and developments requires considerable time and effort, which sometimes works against the short timeframe set within which the Web-based application is expected to be up and running. Nielsen (1997) says that his discount usability approach and guidelines are so easy and cheap to use that people will in fact use them on almost every project. According to him the method has weaknesses however they do provide reasonable answers most of the time, which are much better than the guess work that would result if designs were shipped with zero usability involvement. He says that discount usability engineering enables designs to reach high usability maturity.

According to Atwoon (1995), many in the HCI community believe that different techniques and methodologies are appropriate at different points in the design and development life cycle. He says that we do not know if adoption of discount usability will displace the use of other more knowledge and labour intensive techniques. He says that a more fundamental concern is that interface design may not be as easy as the discount usability guidelines suggest, and he says that one reading of discount usability suggests that empirical techniques are superfluous. According to him a design team really needs to include a professional who is trained in empirical evaluation, cognitive modelling, and design rationale.

2.1.17.2 Conclusion

Researchers such as Cockton & Woolrych (2002), Bailey (2002) and Atwoon (1995) argue against discount usability techniques because the processes used by these methods are not seen as rigorous enough to ensure that all likely usability problems will be identified. Despite these suggestions, discount usability evaluation methods will still be used by designers, so it is important that designers are familiar with the limitations and benefits of using these methods.

2.1.18 Cultural Consideration

2.1.18.1 Introduction

If a Web site or Web-based application is also expected to attract an international audience then careful consideration has to be given to ensure that the words, terms, colours, and groupings of items that are used are relevant and meaningful to international users. Many designers do not understand their target markets and have little understanding of the cultures of people who they expect to use the Web site or Web-based application.

Marcus (2003a) focuses on challenges and opportunities for the user interface design profession in order to gain a better understanding of human experiences as China joins in developing computer-based devices and communication systems. Marcus says that user interface designers must carefully consider the Chinese approach to time, space, logic, communication and interfaces, which might affect user interface design principles and practice.

He says that these fundamental differences would appear to have significant implications for the design of: (a) metaphors, (b) mental models, (c) navigation, (d) interaction, (e) appearance, and (f) the user experience in general. According to him the user interface design community will increasingly need to exchange information with their Chinese counterparts and take into account their experience when philosophising, analysing, and designing the computer-based human experience.

It is very important to fully understand the basics of how a particular culture: (a) thinks, (b) behaves, (c) organises, (d) operates, (e) interacts, and (f) goes about doing basic tasks, if a usable system is to be developed for them. Duncker (2002) says that Maori find digital libraries interesting but difficult to use due to the break down of the library metaphor, which in turn is caused by a number of cultural misfits.

He says that Maori have traditional tribal knowledge repositories that are emotionally and cognitively different from Western libraries, and digital libraries use western classification systems that misrepresent Maori content. He also says that Maori have little experience and therefore little knowledge in western classification systems and publication formats.

Duncker says that it is this cultural experience that leads to a mental model of libraries that has little resemblance to the conceptual model of digital libraries as it has been developed by western designers. He says that Maori are excluded from using digital libraries by the very design of these systems.

Evers (2002) did a study of the applicability of user evaluation methods to a culturally diverse user base and found out that some user evaluation methods are less applicable than others. Evers says that one-on-one observation methods that are common for usability testing with North Americans may not be as appropriate for international users.

Marcus (2001) says that many analysts have studied cultures thoroughly and published classic theories, and other authors have applied these theories to analyze the impact of culture on business relations and commerce, but these works are not well known to the user interface design community.

According to Marcus the techniques of simplicity, clarity, and consistency can improve the communication effectiveness of user interfaces for the Web. According to him in particular the use of appropriate: (a) typography, (b) layout, (c) colour, (d) animation, and (e) symbolism can assist developers to cater to more diverse user communities.

He says that the user interface development process includes: (a) iterative steps of planning, (b) research, (c) analysis, (d) design, (e) evaluation, (f) documentation, and (g) training. According to him if the developers carry out these tasks, they would do well to consider their own cultural orientation and to understand the preferred structures and processes of other cultures. He says that cultures worldwide and even within some countries are very different. According to Marcus the sacred colours in the Judeo-Christian West (e.g. red, blue, white, and gold) are different to the Buddhist saffron yellow or Islamic green.

Marcus and Gould (2000) used the cross-cultural theory developed by Geert Hofstede to analyse the: (a) needs, (b) wants, (c) preferences, and (d) expectations of different cultures. They emphasise that these should be reflected in the interface of Web sites that are targeted for a particular type of audience. They used Hofstede's five dimensions of culture: (a) power-distance, (b) collectivism vs. individualism, (c) feminity vs. masculinity, (d) long vs. short-term orientation and (e) uncertainty avoidance to analyse the

Web sites of different countries. They explored a number of design differences and their review raised many issues of user interface design. According to Marcus and Gould, when designing Web sites the following should be considered: (a) how formal or rewarding should the interaction be, (b) what motives different groups of people have, (c) how much conflict people can tolerate in content or style of argumentation, (d) whether sincerity, harmony or honesty should be used to make appeals, (e) the role that exists for personal opinion vs. group opinion, (f) how well ambiguity and uncertainty avoidance are received, (g) whether shame or guilt will constrain negative behaviour, and (h) what role community values should play in an individualist vs. collective culture.

According to Marcus (1999), project experience has proved that a multicultural design team can make significant progress in debugging cultural biases. He believes that professional designers of specific cultures can design successfully for other cultures, given significant input about the target cultures and time to do iterative improvements in the designs based on user evaluation.

They lists the range of issues that needs to be considered by user interface developers for products that would draw an international audience, such as: (a) text, (b) numbers, data and time formats, and images, (c) symbols, (d) colours, (e) flow, and (f) functionality. They say that except for the first two issues the others are simply ignored by interface designers and point out that it is very important to establish a close working relationship or partnership with natives from the target cultures to identify culturally specific requirements, and to perform usability testing with native users at the same as the domestic usability tests, i.e. before the product is released.

Sun (2001) describes that the localization process is carried on two sub-levels: (a) adjusting the features of the product, including translation, punctuation, dates, weights, measurements, address, currency, and so on to mirror the conventions and needs of the target audience on the surface level, and (b) adjusting the aesthetic appeal, images, colours, logic, functionality, and communication patterns to conform to the target audience on a cultural level. He says that it is the cultural factors that determine the acceptability and usability of an information product such as a localized Web site.

According to Aykin (1999) and Yeo (1996), many software applications markets outside the country of origin are internationalised (common features shared by the entire population) and localised (features common to a group in an international market).

Yeo proposes a strategy to localise software by creating a cultural user interface for each target culture. This cultural user interface according to Yeo would be intuitive to a particular culture and the cultural user interface would take advantage of the shared or common knowledge of a culture that could be defined by country boundaries, language, cultural conventions, race, shared activities or the workplace.

According to Yeo an application that is cultural user interface enabled allows the use of many different cultural user interfaces. He says that these different cultural user interfaces are developed collaboratively with the target cultures, thus the problems associated with localization such as the misinterpretation of elements in the cultural user interface are unlikely to occur.

Yeo categorises factors into overt and covert that need to be addressed before software packages can be internationalized or localized. He says that overt factors are tangible, straight forward, and include publicly observable elements such as: (a) data, (b) calendars, (c) weekends, (d) day turnovers, (e) time, (f) telephone number and address formats, (g) character sets, (h) order sequence, (i) reading and writing directions, (j) punctuation, (k) units of measures, and (l) currency.

According to Yeo, covert factors include: (a) graphics, (b) colours, (c) functionality, (d) sound, (e) metaphors, and (f) mental models. He says that they are intangible elements and depend on culture or "special knowledge". He says that developers have to fully understand covert factors to avoid the misinterpretation of an intended meaning or offending the target culture. Yeo says that the use of the "trash can" icon in the Macintosh user interface may be difficult for Thailand users to recognise since they use wicker baskets. Yeo says that before the cultural user interface can be used, an application must be separated into a functionality component and a user interface component, and then the cultural user interface can be developed. Each of the different cultural user interfaces can be used with the same functionality component.

Creating fluent interfaces for international markets goes beyond translating text and date, time and number formats. To successfully build bridges between worlds, user interface designers must increase their awareness of cross-cultural differences and make changes to the traditional software development process (Russo and Boor, 1993).

According to Nielsen (1990), international user interfaces may or may not involve translation but should certainly involve consideration of the special needs of other countries and cultures. He says that his position is that the foreign version of a user interface is a new interface, and therefore it has to be developed using usability engineering methods similar to those used in the development of the original user interface.

He says that competent translators are necessary, but are not sufficient preconditions for good user interfaces in many foreign countries as translating a user interface is not the same as translating a book. He says that the translator has to be aware of the usability principles for constructing good dialogues in an interactive and dynamic context. Nielsen says that the general lessons from usability engineering apply to the extent that one can never do a sufficiently good job on user interface design without subjecting it to some usability testing with real users.

2.1.18.2 Conclusion

Researchers strongly suggest that for any software application to be successfully used within an organisation, locality, or country, it has to match the expectations, terms and terminology of these users. Designers need to be aware of cultural differences, and the design of Web sites and Web-based applications should be based on a significant level of evaluation and feedback from users of the target cultures.

2.1.19 Usability for elderly users

2.1.19.1 Introduction

The Web provides an opportunity for many elderly users to easily do certain things like pay bills, Internet banking, grocery shopping, booking and paying for travel, researching health issues, or reading online news. However, many of these Web sites are difficult for elderly users to use because the fonts and colours that are used make it hard for them to read the text on the screen, while many have problems using basic pointing and selection tasks common to most graphical user interfaces.

According to Marcus (2003b), HCI issues focus on youth, speed and the early adoption of constantly changing technology. Marcus defines "Universal Design" as user interface design for disabled and elderly users. Marcus focuses on some facts and issues of user interface design for the disabled and elderly which were presented in the Universal Design Conference in Japan, attended by almost seven hundred people from twenty countries, to which he was also invited.

Marcus says that Japan and Scandinavia appear to have been leaders, along with some groups in the US, in calling attention to designing for disabled and elderly people. According to him the elderly population is expected to grow due to better medicine and relative world peace. He says that Japan, with eighteen percent, leads the world in the percentage of senior citizens, which is expected to grow to twenty-five percent by 2014. By 2050 Japan is expected to have thirty-three percent of its population fall within this age group, and most of the other countries in Europe and North America are expected to reach twenty-five percent.

In the US, citizens now can file complaints and discrimination lawsuits regarding technology procured after June 21, 2001, and such lawsuits may require the replacement of expensive technology. This, according to Marcus, has caught the eye of software and hardware developers and provides a strong reason for businesses to make more useable and useful products.

Even though the Internet enriches many seniors' lives, most Web sites violate usability guidelines since these sites are difficult for many seniors to use (Nielsen, 2002d). He says that current Web sites are twice as hard for seniors to use as they are for non-seniors. Nielsen says that one way to improve usability for seniors is to support larger font sizes. He says that larger text for links and command buttons become a more prominent target for clicking.

Hawthorn (2002) suggests that general literature on aging can be used to obtain recommendations for successful interface design for older people. He says that the participation of older users is necessary for turning recommendations on interface design for older users into successful applications. He says that the designers and developers tend to be younger people and they completely ignore the needs, abilities, and limitations of elderly users.

Gregor, Newell & Zajicek (2002) support the new paradigm, i.e. designing for dynamic diversity for older people, and put forward a new supporting methodology for designing systems for elderly people. According to Gregor et al., user-centred design has been developed for user groups with relatively homogonous characteristics. They say that elderly people encompass an incredibly diverse group of users, and even small subsets of this group tend to have a greater diversity of functionality than is found in groups of younger people.

Gregor et al. propose that the user-centred design technique be modified to be called user sensitive inclusive design, which according to them would address the following concerning elderly users: (a) providing a greater variety of user characteristics and functionality, (b) finding and recruiting representative users, (c) identifying conflicts of interest between user groups, (d) the need to specify exactly the characteristics and functionality of the user group, (e) tailoring personalisable and adaptive interfaces, and (f) providing for accessibility using additional components.

As the world's population is aging, HCI designers have both the responsibility and opportunity to create systems that meet the increasing needs of elderly users (Mynatt, 2002). According to her when designing products and software for the elderly it is critical to employ principles of universal design. She says that it is important to have technology in place before a crisis occurs and older adults do not want to purchase products that carry the stigma of aging and disability.

Hanson (2001) lists: (a) vision, (b) dexterity, (c) cognition, and (d) hearing as the common age related problems that have an effect on elderly people using the Web. According to her there are a number of existing technologies that can help seniors overcome difficulties that they may experience with Web access, but these user solutions also have problems.

Hanson proposes a new approach of using server technologies to overcome the problem of the accessibility of the Web for elderly users. According to him it has the advantage of removing the burden from individual users to: (a) know about, (b) install, and (c) pay for ever-changing technologies to access the Web. He says that it would not require Web authors to ensure that their Web pages are accessible.

As people grow older their abilities change. The process of change includes a decline over time in the cognitive, physical, and sensory functions, and each of these will decline at different rates relative to another for each individual (Heller, Jorge and Guedj, 2001). According to Heller et al. this collection of occurrences presents a fundamental problem for the designers of computer systems, whether they are generic systems for use by all ages or specific systems to compensate the loss of function.

Heller et al. suggest that new processes and practices are needed to address design issues for elderly since current software design typically produces an artefact that is static and which has no or very limited means of adapting to the changing needs of users as their abilities change. They say that designers should now aim to design for dynamic diversity, where the products and applications are created based on the users' dynamically changing needs and the technology becomes the servant, not the master of the user.

Hawthorn (1998) discusses aging effects on cognitive areas such as memory and learning, and attention and intelligence. Hawthorn points out that relying on survey based data about elderly users may significantly under-report difficulties that older people may encounter when using a system. He suggests that direct observation or discussion groups be used when researching issues concerning elderly people. Another issue highlighted by Hawthorn that HCI researchers have to be aware of is getting a realistic sample of the older population. He says that older people with less formal education and those coping poorly in the community would likely be underrepresented in respondents or unable to fully articulate their concerns.

According to Worden, Walker, Bharart & Hudson (1997), computers can play an increasingly important role in helping older adults to function well in the society. They say that the graphical user interface contributes to the ease of use of computers, but for older adults even simple mouse clicks can be quite challenging. According to Worden et al. (1997) the trade-off between the accessibility of targets and the amount of information presented is a fundamental issue in human-computer interface design.

They say that elderly people usually have difficulty working with icons that are often utilised to fit a lot of information into one display. According to them the ease (speed and accuracy) with which a user can select an icon depends on the size of the icon and the distance the cursor must be moved. They say that decreased motor ability can have a major effect on the ability of older adults to use a pointing device on a computer. Their previous research has shown that even experienced older computer users move a cursor much more slowly and less accurately than their younger counterparts.

Their findings show that older adults faced more difficulty than younger users when the targets became smaller. Their findings also reveal that older computer users took twice as long and made more than five times as many cursor positioning errors than younger users when moving to small icons. Worden et al. provide solutions to the problem of the decreased ability to position the cursor with a mouse.

One possible solution they provide is to increase the size of targets on the computer display, but they say that this solution can often be counterproductive since less information would be displayed, requiring more navigation. Another option that is provided by them is to arrange the icon against solid borders that do not allow the cursor to overshoot the target, which increases the speed and accuracy of pointing. But they say that the problem with this design is that not all icons can be next to a solid border. The other two approaches suggested by Worden et al. that seem to be practical are the techniques called area cursors and sticky icons. Their study clearly demonstrated that by using area cursors and sticky icons, cursor positioning by older computer users could be improved.
Ogozalek (1994) did a study with sixty-four elderly participants, with an average age of seventy-one, using: (a) a text-only or (b) a multimedia computer interface to obtain information about prescription drugs. She found out that the elderly participants preferred multimedia presentation to text-only. According to her, difficulty with reading due to vision problems was the commonly cited reason for preferring the multimedia system.

2.1.19.2 Conclusion

Researchers strongly feel that serious attention must be paid to the features of Web sites or any other application that might be used by elderly users. Studies show that elderly users are affected by aging. Elderly people not only experience memory and learning difficulties but also a decline in physical capabilities and vision problems. Nielsen (2002d) suggests that designers should use larger font sizes while Worden et al. (1997) propose the use of techniques called "area cursors" and "sticky icons" to improve usability for seniors. Gregor et al. (2002) propose that the user-centred design technique be modified to be called "user sensitive inclusive design", and to address how to select and involve elderly users in the design process.

2.1.20 Aesthetics

2.1.20.1 Introduction

Some cultures place a high value on aesthetics, so designers and developers spend a considerable amount of time ensuring that the interface looks beautiful, while completely ignoring the usability aspects of the product. Users are easily led to believe that a colourful interface will be easy to use and that they will be able to do their tasks to their satisfaction, but in fact the opposite may happen. A good understanding of aesthetics is required so that designers know how to put an appropriate level of effort into the appearance of a Web site or Web-based application without compromising its usability.

According to Wright, Mosser-Wooley and Wooley (2001), to understand potential colour in interface, we need to understand basic characteristics of colour, such as: (a) colour models, (b) the human visual system, (c) physiological principles of colour, and (d) colour effects such as illusions and colour combinations. They emphasise that the designers should design the user interface within physiological principles and display constraints. According to them, colour should be used: (a) sparingly, (b) consistently, and (c) with clarity to help inform efficient mental models, which would result in more learnable and usable interfaces.

"Simplicity", "design quality", and "pleasantness" are all aesthetic notions (Karvonen, 2000). She says that we should strive to make use of hundreds of years of efforts in aesthetics in trying to find out what it is that our aesthetic experiences are made of, i.e. where the beauty of design lays. She says that the existing literature on aesthetic considerations in user interface design makes no real reference to the tradition of aesthetics.

According to her, in those studies that do try to analyse aesthetics, for the most, aesthetic principles are made up ad hoc, without any justification from existing theories of aesthetics that have been around and available for years.

She says that beauty is a power to be reckoned with, and "only a fool would neglect trying to understand such a might".

Karvonen says that the know-how of aesthetics would help to understand: (a) simplicity, (b) the types of knowledge that designers are dealing with, and (c) categorizing objects and the context of making beauty judgements. She says that designers have to learn to understand how effective beauty can be in the Web. According to her, beauty may be the decisive factor when wondering whether or not to trust a service enough to conduct business online.

According to Cowan (1998), if the case of aesthetics versus functionality is taken into account then the aesthetic use of colour is likely to detract from its functional use, i.e. the use of red in an elaborate decorative background pattern will lessen the potency of red as a warning colour. But he says that there are counter-examples to this idea such as road signs, which makes extensive use of colour coding in the very rich visual environment of city streetscapes and are effective at regulating driving. He says that whatever efficacy they may lose from the richness of their surroundings is small compared to the substantial benefits derived from the use of colour coding. Cowan indicates that a lot of attention must go into the design and placement of colour for it to be effective.

According to Tractinsky (1997), conventional wisdom relates aesthetics to our appreciation of it, and our attitudes towards computer systems as well. Tractinsky says that aesthetics may not always coincide with usability, and in fact the opposite might occur. He says that the authors of HCI books acknowledge the role of aesthetics in HCI and warn against a tendency among designers to emphasise the aesthetic elements of user interfaces, because these might degrade usability. Tractinsky says that according to these authors the contribution of aesthetics to HCI should be measured in terms of facilitating information processing, not in terms of engaging the user in a pleasing experience. He says that the HCI literature in general, and on usability in particular, mostly seem to neglect the aesthetics issue completely.

A study done by Kurosu and Kashimura (1995) in Japan provides an insight that interface aesthetics may play more of a role in people's attitudes towards computerized systems than we might be willing to admit. In their study, Kurosu and Kashimura explored the relationships between a priori perceptions of the ease of use of an automatic teller machine, which they termed "apparent usability". Kurosu and Kashimura surprisingly found a high relationship between interface judgments of aesthetics and perceived usability before actual use.

According to Tractinsky, usability should actually be measured during or after system use. Tractinsky says that if Kurosu's and Kashimura's findings are robust, then the importance of aesthetics in HCI should rise considerably given the relationships between interface aesthetics, initial perceptions of usability, and later attitudes towards computers.

Tractinsky conducted three experiments in Israel based on Kurosu's and Kashimura's finding to validate and replicate in a different cultural setting concerning the relationships between users' perceptions of interface aesthetics and usability. The results of the experiments indicate that people's perceptions of apparent usability and aesthetics are quite high in general. Tractinsky expected the correlations in Israel would be lower than those obtained in Japan but in fact it was the opposite.

Tractinsky concluded that aesthetic perception and its relation to HCI relevant constructs are culturally dependent, and that our current knowledge limits our ability to accurately predict how culture influences HCI issues. He says that the results provide further support for the contention that perceptions of interface aesthetics are closely related to apparent usability and thus increase the likelihood that aesthetics may considerably affect system acceptability.

According to Bauersfeld & Slater (1991), better colour tools would make advanced colour concepts accessible to a broader user population since existing colour tools are typically indirect and modal in nature. They emphasise that colour tools are needed that will allow users to view colour in the context in which it will used and in relation to the forms and colours around them. They believe that colour tools should be developed that respond to a more sensitive understanding of relationships among colours. According to Bauersfeld & Slater, one way to understand more about how users plan to deal with colours is to look at how designers and artists are trained to think about colours.

Colour is important in interfaces because the appropriate use of colour can make interfaces easier to understand and use (Marcus, 1989). He says that current design of user interfaces often occurs with too little attention given to solving explicit coding problems and to achieving successful communication impact through colour. According to Marcus, future users will become more sophisticated together with the hardware and application, and more colours will be used to make people's work more interesting and pleasing. But he says that more research is needed: (a) in applying colour to two- and three-dimensional interfaces, (b) in relating colour to time and sound, and (c) investigating the psychological impact of colour user interface over long periods of time.

Meier (1988) says that colour is used in computer graphics to: (a) code information, (b) call attention to items, (c) signal a user, and (d) enhance display aesthetics. But he says that using colour effectively and tastefully is often beyond the abilities of application programmers since colour crosses many disciplines, and aspects such as human colour vision are not completely understood.

He says that even though they have compiled a comprehensive set of guidelines for the proper use of colour, these guidelines cannot provide all of the aesthetic and human factor knowledge necessary for making good colour selections. According to Meier they have developed and implemented ACE, a colour expert system, which embodies colour rules and applies them to user interface design. They found out the colours which ACE selected were better than a random selection and also better than what a programmer with little aesthetic experience would have chosen.

He says that the goal of the implementation was to test whether an automated mechanism would be a viable solution to the problem of choosing effective and tasteful colours.

2.1.20.2 Conclusion

Various studies suggest that designers should use aesthetics carefully, consistently, and clearly to enhance learning and understanding, while at the same time making the interface usable and appealing. Tractinsky (1997) points out that aesthetics may not always coincide with usability, and suggests that usability should be measured during or after system use, but not based on prior perceptions of ease of use.

2.1.21 User-centred and participatory design

2.1.21.1 Introduction

There is a common belief that user participation and user-centred development are necessary for successful Web site and Web-based application development. They enable designers to identify likely audiences and to spend a considerable amount of time learning about them. Also, they allow users to actively take part in design discussions, so that designers can make improvements based on their suggestions and evaluations. These activities enable designers to design and develop usable applications.

To find out the extent to which the concept of user-centred and participatory design techniques are used, Vredenburg, Mao, Smith and Carey (2002) conducted a survey of user-centred design practitioners. They described user-centred design to the respondents as: (a) the active involvement of users for a clear understanding of user and task requirements, (b) iterative design and evaluation, and (c) a multi-disciplinary approach.

They found out that user-centred design methods were generally considered to have improved product usefulness and usability although the degree of user-centred design method adoption was quite uneven across different organisations. They found that there was a lack of measurement of user-centred design effectiveness and any common criteria across the industry.

Their survey also found that some common characteristics of an ideal user-centred design process, such as: (a) total user experience, (b) end-to-end user involvement in the development process, and (c) customer satisfaction, were not found to be used in practice. According to their findings, if user-centred design was to have an impact then two or more user-centred design specialists should be part of the design team. They also found that the cost and benefit trade-off plays a major role in the adoption of user-centred design. For example, field studies were infrequently used because they are costly, whereas heuristic evaluations were heavily used since it was relatively easy and less costly.

Jokela (2002) proposes an outcome-driven, method-independent process model of user-centred design, which he says was developed based on experiments in industrial settings. He says that the model takes ISO 13407 and ISO 18529 as its base and has six distinctive features. He says that the experiments indicate that the model makes the essentials of user-centred design more comprehensible and easier to define, and it also enables the integration usability engineering and interaction design.

Understanding the user requirements is crucial to developing interfaces to the user's liking. Hansen, Petrelli, Karlgren, Beaulie and Sanderson (2002) used user-centred design methodology and techniques for the elicitation of user requirements to determine the first phase of user interface design for a cross-language information retrieval system. They state the importance of users being involved from the beginning, which helps to integrate users' expertise and knowledge, and to understand what people are doing: (a) how, (b) when, and (c) why. They say that promising solutions can be tested with these users to verify choices. According to them the design cycle ends when a satisfying solution is reached and implemented, and the prototype generated at this stage is very close to the final system.

According to Bevan and Curson (1999) ISO 13407 describes how human-centred design processes can be used to achieve usable systems. According to Bevan and Curson the principles of ISO 13407 can be integrated into existing development processes incrementally to achieve an appropriate maturity level. They say that ISO software quality standards make quality in use the ultimate objective of systems design, thus providing the authority to give usability a very strategic role in the development process. Bevan and Curson state that to achieve quality in user interfaces requires a user-centred design process and the use of appropriate usability evaluation techniques.

According to Chin, Rosson and Carroll (1997) the users in traditional systems development processes are used to provide information that is used by developers to build the system for them. The users play the part of informants but do not do analysis work. They say that users are included in requirements analysis but are not empowered during the most formative stages of software development. This they see as a major drawback since they think that it limits both the quality of the requirements analysis and the effectiveness of user-developer collaboration over the entire course of a project.

Chin et al. successfully developed and evaluated an educational project based on participatory design, which was a computer-based, collaborative learning tool and environment in support of middle and high school physics. They used a scenario-based design framework called the task-artefact framework (TAF). In this framework, the question of direct user participation in requirements analysis becomes an investigation of users participating in the analysis of their own usage scenarios. According to Chin et al. scenario-based design generally facilitates user participation in system development since scenarios are: (a) informal, (b) evocative, (c) work-oriented, (d) can be sketchy or highly detailed, and (e) equally accessible to various stakeholders in a design.

They say that most important is that the scenarios belong to the users, because they describe and exemplify the users' own practices and transform the user from the recipient or consumer of the system development process into an expert participant. They say that users must: (a) feel engaged, (b) have a stake, (c) have effective access to relevant information, (d) have status, (e) have power, and (f) have a scope of action sufficient to allow them to take positions and contribute to decisions. According to Chin et al. effective participatory design requires a common environment in which both the developers and users are equally capable of working. The importance of an early and on-going focus on users in interactive system design is widely accepted.

A study done by Butler and Fitzgerald (1997) on companies and organizations that involve users in such projects found that user participation is a major contributor to success in systems development, but it did not guarantee the operation and use of the information systems once developed.

According to Butler and Fitzgerald this happens because of the fears of influential users in regard to the changes brought by the introduction of the new systems in their work-related roles and responsibilities, which were not addressed prior to development or implementation. They say that there is a tendency in organizations to view the development process as a mechanism for the resolution of problems of a political nature that impact on the operation and use of information systems. They say that a distinction has to be made between the benefits that accrue to the development process and its product, and the impact that participation has on the eventual introduction and use of the product.

According to Wilson, Bekker, Johnson and Johnson (1997), in practice involving users poses many problems and requires designers to balance conflicting demands. Wilson et al. (1997) did a case study involving the design of a bespoke application and provide a detailed account of the obstacles to, and facilitators of, user involvement encountered during design activities. They present obstacles in terms of issues such as: (a) contacting and selecting users, (b) motivating users, (c) facilitating and mediating meetings, (d) choosing design representations, and (e) offering points of focus for user contributions. They say that given the designers have to make difficult decisions in balancing conflicting demands, it is important that they recognise the consequences of their decisions for user involvement.

Wilson et al. draw lessons from their case study that cover a wide variety of issues that have to be considered when involving users in design, such as: (a) motivating all the stakeholders, (b) selecting a representative cross-section of users, (c) involving a champion for the cause of user involvement, (d) organising meetings effectively, (e) not expecting users to be designers, (f) following user involvement through to the end, (g) facilitating later involvement through earlier involvement, (h) educating users about the whole design process, and (i) organising both individual and group meetings for users to voice their opinions and to resolve differences of opinion with other users.

2.1.21.1 Conclusion

Various studies show that participatory and user-centred design involves design in the workplace, incorporating users not only as experimental subjects but also as members of the design team. Users are meant to be active collaborators in the design process rather than passive participants. Studies indicate that the use of user-centred methods and techniques such as field studies, which are not common in industry, enable designers to produce highly usable applications. User-centred and participatory design are expensive and time consuming, and according to Wilson et al. (1997), they require balancing conflicting demands.

2.1.22 Iterative design

2.1.22.2 Introduction

Iteration allows several rounds of improvement of design ideas based on testing and evaluation. If users are involved in testing and evaluation then a more usable application can be designed and developed.

The use of an iterative design process is demonstrated by Salomon (2000), in which a small systems development team from Apple Computer designed and developed an interactive information kiosk. Salomon provides an insight into the interface design process and the specific issues related to the design of interactive systems. The design process used resulted in a successful information kiosk, which was suitable to a variety of users within a casual usage environment.

The developers adopted an iterative design process, based on successively enhanced prototypes, which were visually based. Salomon states that the design team used three distinct phases: (a) the initial design specification phase, (b) the storytelling prototype phase, and (c) the functional prototype phase, to identify user requirements and the functionalities of the system. According to him there was a continuous interaction of the design team with the users to get feedback, which enabled the designers to improve the system's interface to the users' liking, and also the development process used encouraged system development from the users' point of view.
The specific examples provided by Salomon show: (a) how progressively more refined designs arose from the initial rough ideas, and (b) how early and frequent testing of prototypes uncovered problems that were not difficult to correct, and were often related to the graphical representation. Salomon also explains how the design team used usage data to uncover good and flawed aspects of the interface. He says that the insights acquired from the usage data of one system can provide a basis for design decisions for a new system under construction.

The iterative design process was also used by Fogg, Cutler, Arnold and Eisbach (1998), which helped them to identify and understand their intended users, and enabled them to design the interface of a prototype of their product to the liking of their users. The prototype was a haptic device for interpersonal entertainment known as HANDJIVE. Their prototype was developed based on successive user testing. Fogg et al. (1998) defined the user groups for their product early in the design process. At this stage all their ideas about the technology and interface were put aside and their main focus was on identifying the user group who would be most likely to use their product.

Fogg et al. used brainstorming, investigation, and observation of people to narrow the user group to freshmen and sophomores in a college class. They wanted to develop a system that would allow people to interact playfully with each other in any context in which they were isolated in silence. According to them they thoroughly studied the user group in order to understand the user needs, behaviours, attitudes, and contexts, and then construct user profiles based on their user study.

The investigation and insights into the user group enabled them to narrow the design space in order to meet the specific needs of the users. Fogg et al. created various narrative scenarios that described how the users would overcome their isolation in the class by using the technology. According to them they understood how the users' needs would be met and then the successive prototypes were built and tested with the users.

A paper by Bloomer and Wolfe (1996) of the Hiser Group revealed that usability and user interface design were relatively unknown in the Australasian software development market. They say that the Hiser Group has developed a three-phase method for creating user-centred interfaces, which aims to involve users in all phases of the design process in an iterative manner. According to them the Hiser Group promotes the need to design for usability through commercial training, frequent speaking engagements, and publications.

Bloomer and Wolfe say that even though some of the large organizations in Australia have human factors groups, it is impossible to recruit skilled consultants. According to them there are several universities in Australia that include HCI subjects, but only two have started dedicated degree courses in usability. They also add that CHISIG, the Australian-based professional HCI organization, is small and primarily academic and research oriented. Bloomer and Wolfe say that to pioneer HCI in Australia it is necessary to hire and cross train: (a) designers, (b) ergonomists, and (c) psychologists, and it is necessary to import senior staff from overseas.

There are still many unanswered questions about the effectiveness of iterative design method. According to Bailey (1993) there are at least three major difficulties that one must deal with while using an iterative methodology: (a) to recognise the usability problems based on feedback, (b) once a problem is identified designers must figure out a way to fix the problem with a design change, and (c) trying to take a weak design and attempting to attain a quality design through iteration. According to him, designers in his case study struggled with all three of these difficulties.

His findings suggest that iterative design methodologies can only improve designs within a limited range. His study indicates that there were still usability problems after the last iteration. He says that the better the design to start with, the better the results would be after iterations. Bailey says that there are a number of techniques and methods that can be used to ensure good interface design, and he adds that the trick is to know the strength and limitations of these techniques and to apply them at the appropriate time.

According to Bailey usability can be improved if methods for bringing about better usability can be improved. He says that designers need better techniques for identifying real problems that cause difficulties for users that must be found, and once these problems are identified there is a need to learn how to fix the problems without introducing new problems.

2.1.22.2 Conclusion

Several studies show that iteration enables designers to identify and fix design problems, which helps to enhance the usability of an application. Iterative design should involve users to meet their specific needs. Bailey (1993) thinks that iterative design can not fix all the usability problems, since fixing one design flaw may introduce other usability problems. He believes that other methods for enhancing usability must be improved if usable applications are to be developed.

2.1.23 Internet commerce

2.1.23.1 Introduction

Electronic commerce provides an opportunity to significantly increase a customer base both locally and internationally. Designing e-commerce sites presents an enormous challenge when it comes to doing business using Web sites. Designers need to pay serious attention to identifying and fixing all likely usability flaws of e-commerce sites so that users will feel confident and not hesitant to engage in an electronic transaction. The usability of an e-commerce site will determine its survival on the Web.

Unlike application software where the users are well defined and known, Web sites will have visitors for a multitude of reasons: (a) just casually surfing, (b) seeking information, or (c) wanting to perform a business transaction. Each user role and associated user goals embody a unique set of requirements and needs with regards to the design of the Web site (Agarwal and Venkatesh, 2002.) According to Agarwal and Venkatesh there is considerable diversity in the devices through which users can access Web sites, ranging from cellular telephones to television sets to a personal digital assistant. They say that design decisions as well as usability testing need to take such device diversity into account.

Torkzadeh and Dhillon (2002) used means fundamental objectives to measure the success of Internet commerce. For their survey they used a 5-factor, 21-item scale that measures means objectives, and the second instrument that they used was a 4-factor, 16-item scale that measures fundamental objectives. For the means objective their survey result indicates that Internet product choice and online payment influences the online purchase, and for the fundamental objectives, shopping convenience and ecological issues are what the customers perceive to be important for Internet commerce. According to Torkzadeh & Dhillon these instruments are reliable, valid, can be used with confidence by academics and practitioners, and can also be used by executives to distinguish between effective and ineffective Internet sites.

McKinney, Yoon & Zahedi (2002) propose an expectation-disconfirmation paradigm with empirical theories in user satisfaction to measure Web-customer satisfaction during the information phase. They separate Web site quality into information quality and system quality and propose nine key constructs for Web-customer satisfaction.

Usability considerations should be of prime importance in the design of an electronic commerce Web site (Kubilus, 2000). According to him, while the number of e-commerce Web sites has increased rapidly over the last three years, the satisfaction of e-commerce users has generally decreased. He says that this has happened because too little attention has being paid to the human factors that affect whether a Web site can be used easily, accurately, and without losing user interest.

Nielsen (2000) says that there is a “glorious future” for e-commerce, but usability problems are rampant and they cause an enormous loss of sales. He says that e-commerce sites often echo so called company-centrism where the site builders’ aim is to present the company as they see themselves, without the regard of site visitors, let alone the potential customers’ needs.

According to Nielsen the reality was that for many years user interface development was not very high at all on agenda of companies, i.e. sell first, customer experience later. He says that creating awareness among the site developers that paying attention to usability today can easily solve many of the problems with e-commerce sites, and that investing time and money in it will ultimately result in more sales and greater revenue. Nielsen says that usability testing before, during, and after the development of a site can easily detect and cure many problems.

According to Nielsen (1999), a survey sponsored by Danish E-Commerce on users who have bought products on the Web suggests that: (a) convenience and ease of use are the main reasons people buy using Web sites, (b) only five percent of users’ visits result in a purchase being made, and (c) an increasing number of users are buying from international Web sites.

In their usability testing of twenty e-commerce sites they found out that users were capable of buying in fifty-six percent of the cases where they attempted a purchase from the five percent of those who were interested in buying something. Nielsen says that the short-term focus of owners and designers of e-commerce Web sites should be changing shoppers to buyers and on making it possible for users to complete the transaction once they have decided to purchase.

2.1.23.2 Conclusion

Usability is key to the survival of e-commerce sites, as shown by various studies. A study done by Kabulis (2000) and another by Nielsen (2000) show that there has been a rapid increase in e-commerce sites, but usability issues have been the major drawback of most of these sites. These issues have prevented the sites from becoming competitive or successful.

2.1.24 Metaphors

2.1.24.1 Introduction

Metaphors are widely used to enhance the user interfaces of computer software. Developers have used desktop metaphors and agent metaphors etc. to enhance the usability of computer interfaces. Any Metaphor that is used with the design will need to be meaningful for the user.

Orubeondo & Mitchell (2000) believe that user interfaces will not reach maturity until end-users can use them productively without learning the operating system. They say that many post-PC devices provide exactly this kind of interaction. They say that Web browsers have arrived on the scene with their singular metaphor that is easy for end-users to learn, and the interface is the same regardless of what application you are using. According to Orubeondo and Mitchell, navigating the user interface is another important issue that makes the difference between a good and a bad end-user experience. They say that users should not go more than three levels into any pull-down menu to accomplish a task.

Stubblefield (1998) states that there has been an increased recognition of the metaphor's large role in the design process, including its influence on program functionality, system architecture, and knowledge representation. Stubblefield was part of the development team that built Machinability Advisor, which was to assist mechanical engineers in improving the manufacturability of machined parts. According to Stubblefield the project was conceived to be a "spelling checker" for machinability problems, and he explains the influence of the "spelling checker" metaphor on the design of the project and the changes that occurred in the understanding of the metaphor itself with the design team as the designed matured.

Stubblefield explains how the metaphor's social context, particularly the differences in the way team members interpreted it and the effects of those differences on the teams interaction, had an affect on the development of the project. Stubblefield says that metaphors are figures of the form "A is B", where B is said to be the source of the metaphor and A is the target. He says that the interpretation of a metaphor is a process of discovering which properties of the source may be valid and useful to understanding the target.

He says that according to science there are three components of analogies: (a) the positive analogy which consists of those properties of the source that are known to apply to the target, (b) the negative analogy which includes sources properties that are either untrue or irrelevant to the target, and (c) the neutral analogy that contains those that have not yet been classified as positive or negative.

According to Stubblefield the design metaphor can seldom be classified as simply positive or negative in transferring properties from the source to the target. He provides an example of direct manipulation interfaces where instead of grasping an object, we select it, and placing one object on top of another such as a document on a printer icon is not an act of physical stacking but of invoking some operation. Similarly he says that properties that might initially seem to be part of a negative metaphor are often modified during the design process to maintain the metaphor's consistency.

Stubblefield says that the use of the "trash can" icon to invoke file deletion is unlike real trash cans, as trash can icons never become full. He says that this negative aspect of the metaphor can cause problems for those users who only empty their physical trash cans when they overflow, who may neglect to empty their computer trash, eventually causing disk storage to fill up with deleted files.

Stubblefield adds that some interfaces attempt to repair the metaphor through such techniques as prompting the user to empty the trash when logging off the system. According to him it is important to understand the process of adapting the positive and repairing the negative components of a design metaphor. Stubblefield also says that metaphors can also be obstacles. As the design matured in their project, the metaphor interfered with their ability to respond to an emerging understanding of the user's needs and abilities.

Marcus (1994) states that future user interface designs must optimise the use of metaphors to meet users' needs and preferences. Marcus describes metaphors as: (a) the fundamental concepts, (b) terms, and (c) images, by which and through which information is easily recognized, understood, and remembered. He says that metaphorical techniques can vary widely across systems and change over time. He says that new metaphorical references and enrichments of existing references are occurring all of the time.

According to Marcus, metaphors are a fundamental basis for all human communication, and the kinds of metaphors people have in their mind are changing. He says that an appropriate metaphor balances delicately expectation and surprise on the part of the user. Marcus says that if the substitution is too alien to the user's culture, the user will become confused, disinterested, distracted, bored or opposed to the message carried by the metaphor. He says that achieving the right mixture of metaphorical references in a complex user interface is a design task.

He says that the principles of visual communication such as: (a) organisation, (b) economy, and (c) communication should be adopted as guidelines for the design of metaphors. According to him, in addition to providing familiar references, designing metaphors for advanced user interfaces invariably leads to the introduction of some new concepts, terms, and images that may lead to confusion, alienation, or even rejection. Marcus says that establishing metaphors within a large community of users is an iterative process over a period of several years, even decades.

2.1.24.2 Conclusion

While metaphors are recognised as very useful, and help to make interfaces more relevant and easy to use for users, studies indicate that care must be taken to ensure that their use does not have a negative impact. Any metaphor used must be thoroughly evaluated by the target audience to ensure that users are able to relate to it and that it will not cause any confusion.

2.1.25 Future user interface design considerations

2.1.25.1 Introduction

Continuous research is needed to improve the methods and techniques that are currently being employed to design and develop usable applications. Designers will need more research-based software tools to help them learn about target audiences. They will also need research-based software tools to enable them to quickly put ideas into designs and test them with users so that applications can be developed within a reasonable timeframe.

According to Thomas & Macredie (2002), new technologies are always penetrating users' lives at an increasing rate so that users no longer know what functionality to expect from the refrigerator, television, car and so forth. They say that users' use continuously develops over time, and new possibilities emerge while others fade away. According to them, present usability engineering methodologies provide little support in understanding how the use develops right from the first meeting with the whole product till we later discover small facets of the technology, and more importantly how this development of use may be supported by the design of the technology.

Thomas & Macredie strongly emphasise that established usability engineering methodologies are ill suited to emerging technologies. They point out that one of the traditional approaches of ensuring usability, laboratory-based usability testing, is largely meaningless in this context. According to Thomas & Macredie the "new usability" challenge is how to respond quickly to emerging technologies and applications, and they consider it to be an incredibly important issue. They are concerned that usability as currently defined will become increasingly marginalized.

Sutcliffe (2000) says that HCI will need to adopt a new perspective on delivering theoretical insights into design advice in the new millennium, and that design by reuse will become a dominant paradigm. Sutcliffe points out the studies of industrial practice suggest that the systematic, methodical practice of HCI is not widespread. Sutcliffe agrees that HCI needs theories to base designs on, but he says that the use of cognitive theories and models has considerable restrictions on its applicability to human-computer design problems.

According to Sutcliffe the restrictions become severe for complex multimodal and multi-user interfaces, and the complexity presents a barrier for delivering HCI knowledge as predictions for usable designs in a manner that is understandable to the designers. He says that the basic problem is how theory-based knowledge may be conveyed to designers who are not experts in cognitive science. Sutcliffe says that the alternative is to provide usability via examples of good practice, and/or reusable products. He emphasises that claims and the task-artefact theory be used since both follow the empiricist tradition of HCI that sees usability develop through incremental improvement of artefacts by evaluation and redesign.

2.1.25.2 Conclusion

A study by Thomas & Macredie (2000) argues that future usability engineering methodologies should provide support for learning how application use develops through the various stages of an application's life, so that more usable applications can be developed. Sutcliffe (2000) thinks that in the future there will be a need to provide usability via examples of good practice and or by reusable applications.

2. 1.26. Other usability related papers

Today the issue of usability is critical as a differentiator between competing companies (Schaffer, 2001). But he says that very few companies have successfully integrated usability engineering, which means that only few companies are good at building applications that are practical, usable, useful, and satisfying to use. According to Schaffer, without the appropriate skills, methods, infrastructure, and support there is little hope that usability will be institutionalised. He says that the best predictor of the success of usability institutionalisation would be the presence of a good executive champion who provides direction and resources. Schaffer says that without a champion, usability staff will not be held as a part of a cohesive strategic effort – they will not be protected, and they will not survive.

A study done by Nielsen (2002b) suggests that Web usability is improving, but at a very slow rate. His study revealed that usability improved by four percent from the end of 2000 until mid 2002, after publishing guidelines for e-commerce usability. According to him, if this level of improvement is sustained then the ideal of ninety percent guideline compliance will be reached in 2017. He says that it is annoying to spend so much time documenting 207 principles that are known to make online shopping easier, only to discover several months later that most of these best practices are still not in place on most sites. But he says that new technologies take time to mature, and the fact that sites do implement ever more of his recommendations is a cause for celebration. Nielsen says that non-US e-commerce sites are three years behind US sites for usability. He says that this may be due to: (a) executive management's emphasise on usability in US, and (b) the relative lack of resources for non-US sites. According to him most aspects of usability are cheap to implement, which requires Web sites to avoid fancy designs, and focus on simplicity and user needs.

Usborne (2003) points to three areas of online information in Web sites that need immediate attention by designers: (a) tell the visitors what it is that the Web site actually does, (b) write in a style that actually connects with the visitors (more personal and sincere), and (c) tell the visitors clearly what to do.

Hansen (1997) describes how she took on the challenge of designing a new user interface for Internet Profiles Corporation, whose clients included nearly all of the top twenty World Wide Web sites. She describes that she used techniques such as: (a) onsite interviews to understand customers and their needs early in the design process, (b) rapid iteration of paper prototypes on internal and external subjects, (c) hiring an external graphic design firm to create a professional attractive look for the product, and (d) the critique of their work by co-workers. She says that a good user interface design can be delivered in little time, even if there is only one person to drive the effort, if the company has a person with the right sets of skills and knowledge.

Boucher and Smith (2000) provide accounts of how internal politics played an enormous part in the delay of the redesign of California State University's Web site by more than one year. They suggest that there are four ways to begin assessment of the current site's usability: (a) determine if it is effective, (b) determine if it is intuitive for first-time users, (c) determine if it is expedient for return visitors, and (d) determine if users are drawn to or compelled by it. They say that while stakeholders will have an opinion, it is important that the developer must not be caught in the internal politics of the organization where there is no clear direction from management. Boucher and Smith provide some basic organizational and political usability guidelines to make a case for the usability of Web sites.

2.2 Conclusion

If used wisely and appropriately, the following practices should enable designers and developers to design and develop Web sites and Web-based applications with human elements: (a) acquiring a good understanding of users through user studies, (b) user participation, (c) the active involvement of users in the design and testing of user interfaces, (d) iterative design and development to ensure that the product developed will be usable and useful, (e) the use of task analysis as a key to understanding what users will want to do when using a Web site or Web-based application, (f) the use of evaluation techniques to help identify most of the likely usability problems before the product is released, (g) the use of prototyping to evaluate various design ideas with the users so that the most appropriate design can be developed into a fully functional application, (h) the involvement of usability professionals in the design team so that user-centred methods are enforced to design and develop applications, (i) providing personalized user experiences to help maintain a lasting relationship with customers, (j) the use of relevant and meaningful metaphors to provide for real life experience to enhance usability, (k) the consideration of usability issues for elderly users since they are the fastest grouping user group of the Web, and (l) the consideration of cultural issues to ensure that target audiences are not offended.

Chapter Three

3.1 Methodology

The research on user interface design practice for Web sites and Web-based applications in New Zealand was carried out using the survey method. It was anticipated that the survey method for this research would provide a quick and easy response from the sample population within the allocated time period for data collection. The survey was planned to be undertaken from the 1st of February, 2004 and was expected to be completed by the 30th of March, 2004.

Two different surveys were carried out, which were as follows: (a) to survey the Web design practices that are used by organizations and Web development companies to design and develop user interfaces for Web sites, and (b) to survey the six major universities in New Zealand to find out what is being taught, and what resources these universities have in relation to the HCI subjects that they offer as part of their Information Technology curriculum.

The survey method was also determined the best method to gain information on the level and coverage of HCI courses by the six major universities in New Zealand: Auckland University, Waikato University, Massey University, Victoria University, the University of Canterbury, and Otago University. This method also made it possible to find out if these universities have appropriate human resources and facilities for teaching and research work in HCI.

The World Wide Web was also used to identify HCI Web sites that made it possible to compile data on: (a) universities worldwide that offer HCI education, (b) universities worldwide that have a reputable usability or HCI laboratory to support teaching and research work, (c) the number of private organizations worldwide that have a reputable usability or HCI laboratory, (d) the number of well known HCI conferences, and (e) if there are any HCI curriculum proposed by any of the renowned worldwide HCI associations for tertiary education providers.

A comprehensive literature review was undertaken on user interface design, usability, and HCI, to identify user interface design practices that enhance usability. A wide range of sources were used to cite the published research papers and articles on user interface design, which included: (a) the ACM Digital Library, (b) the Communications of the ACM, (c) ACM interactions, (d) CHI (Computer-Human Interaction) conference proceedings (e) the ACM SIGCHI Bulletin, (f) the IEEE Computer Society's Digital Library, (g) the Information Systems Research journal, (h) IMS Quarterly, (i) the New Zealand Journal of Applied Computing and Information Technology, and (j) the HCI journal. Several useful white papers by well known usability professionals and practitioners are also included in the literature review from the following sources: (a) Alert Box's Web usability site www.useit.com, (b) User Interface Engineering's Web site www.uie.com, and (c) Usability New's Web site www.usabilitynews.com (a British HCI group).

The questionnaire for the two surveys was developed based on the literature review. Several drafts of the questionnaire for the two surveys were made based on corrections and suggestions that were made by the research supervisor. The final copy of the first survey that was used to survey industry had fifty three questions with each question providing a number of alternative answers from which the respondent could choose. Extra space was provided for written responses in case the alternatives provided were not applicable to the development projects. It was estimated that it would take a respondent approximately fifty minutes to answer the entire questionnaire. The target audiences for this survey were developers, designers or anyone that takes part in design and development.

The final copy of the second survey, that was used to survey the six major universities in New Zealand, had 19 questions, with each question having a number of alternative answers from which the respondent could choose. Extra space was provided for written responses in case the alternatives provided were not applicable or appropriate. It was estimated that this survey would take about twenty five minutes to complete. The target audience for this survey were the heads of departments or schools, or the senior lecturers of departments' offering HCI courses.

Cover letters were designed for both surveys which were included with the questionnaires. The covering letter informed the participants: (a) why the research was being conducted, (b) whom they could contact if they had any queries or needed additional information regarding the research, (c) that they could get a copy of the results of the research if they wished to, and (d) to assure them that their privacy would be maintained at all times.

The survey participants from industry were identified by using three New Zealand Web directory sites: (a) www.webdirectory.natlib.govt.nz/index.htm, (b) www.nzs.com, and (c) www.piperpat.co.nz/nz/index.html. An initial list was compiled which had a total of two hundred small to large organizations, companies, and government departments that each had an interactive Web site. Web development companies were other survey participants, who were considered to be very important for the survey. A comprehensive list of Web development companies in New Zealand was compiled using the last two years of the Net Guide publications (a New Zealand monthly computer magazine), i.e. from early 2002 till early 2004. This process revealed that there are about eighty established Web development companies in New Zealand.

The selected survey participants were then contacted through phone and email inviting them to take part in the survey. Once the participant agreed, then either the survey form was posted with the return post paid, emailed as an attachment, or personally delivered with the return post paid. All the participants were informed that they had up to two weeks to return the completed survey form. Up to five hundred survey participants were identified and contacted to invite them to take part in the survey over the period of three months from February to April 2004. Of the one hundred and thirty six that agreed to take part, a total of sixty two participants returned the completed survey form.

One of major reasons given by organizations, companies and government departments why they did not take part in the survey was that Web site design and development was outsourced to a Web development company – they had no idea of what processes were used in the design and development of their site, and had no working relationship with the Web development company anymore. In some cases it was mentioned that the Web site was designed and developed by students, or a staff member who has since moved on. The majority of the Web development companies that did not take part in the survey stated that they were too busy to take part in the survey while others said they were not interested despite mentioning the importance of the study. One surprising thing that came up when taking to people to encourage their organization to take part in the survey was that there was no awareness of why the organization had a Web site, and in some cases staff members did not know that their employer even had a Web site.

For the survey of the six major universities in New Zealand, the postal addresses for the heads of department for computer science and information systems were identified through the universities' Web sites. The survey questionnaire was posted to seven heads of department, with at least one head of department from each of the six major universities. A stamped addressed envelope was also enclosed to encourage a reply. The universities responded to the survey promptly, and six completed survey forms were returned within two weeks.

Table 3.1 shows a plan that was drawn up early in July 2003. It lists all the activities related to the research that was carried out.

Table 3.1: Timetable of research activities

Activity	Start by:	Completion by:
Writing a proposal	July	30th July
Providing annotated bibliography	July	September
Literature review to identify good practices	July	November
Writing up the survey questionnaire	December	20th December
Identifying the participants	December	March
Posting the survey forms to the participants	February	March
Receiving the survey from the respondents	February	April
Compiling the results	May	15th May
Analysis and interpretation of results	15th May	30th May
Writing the research report	May	June
Submission of the first draft to the supervisor	1st July	15th July
Submission of the second draft to the supervisor	24th July	10th August
Submission of the report for making	16th August	

The data collected from the industry survey was quantified and subjected to analysis to determine the extent to which a particular design practice is used by the developers and designers of the surveyed population to develop user interfaces for Web sites and Web-based applications. The results helped to determine the overall awareness about usability issues in Web sites and Web-based applications in New Zealand. In particular, the results determined: (a) the level of awareness of practices for designing usable Web sites and Web-based applications, (b) if any action is required to make usability issues and considerations an important and integral part of the design and development of Web sites and Web-based applications, and (c) if designers and developers need training in using techniques and methodologies to enable them to design and develop usable Web sites and Web-based applications.

The data collected from the six major universities helped to determine: (a) if universities in New Zealand are on par with universities from other first world countries in terms of their HCI curriculum, and (b) what changes or improvement, if any, the universities should adopt in their IT curriculum for

HCI courses to enhance and foster education, knowledge and skills in usability for their graduates.

Chapter 4

4.1. Results of the Survey done in the industry

1. What is your job title?

Table 4.1.1 Participant for the Survey

	Number	Percentage
Developer	36	58%
Systems analyst	5	8%
Tester	1	1%
Usability Engineer	0	0%
Others – IT Manager, Project Manager, It director, IT Consultant, Development Manger	20	32%

2. Which of the following do you think is critical for the success of Web sites? (Tick all that apply)

Table 4.1.2 Important design factors for Web sites

	Number	Percentage
The content it provides	59	95%
Ability to easily locate information	61	98%
Easy navigation	50	81%
Easy download	46	74%
Functionality of the Web site	30	48%
Aesthetics	33	53%
Use of appropriate graphics	33	53%
None of the above	0	0%
Others – easily able to maintain information, compliance with government needs, standardization	3	4%

3. Do you think that the usability professionals should be part of the design and development team?

Table 4.1.3 Usability professional as part of design team

	Number	Percentage
Yes	47	76 %
No	12	19%
Don't know	3	5%

4. If your answer to question 3 is no, why not? Tick all that apply.

Table 4.1.4 Reasons for non-inclusion of usability professional in a design team

	Number	Percentage
Usability professionals will be a hindrance to making quick design decisions	3	25%
Usability professionals will not fit in with the short time period of Web development and will delay the completion of the Web site	1	8%
Developers have enough knowledge, skills, and experience to take care of usability issues	8	67%
It will add to the cost of design and development	7	58%
Clients are not willing to pay extra for usability evaluation and assume that the developers will take care of usability issues on the Web site.	9	75%

5. Do you think that usability professionals should lead the way in designing the user interface of Web sites or Web-based applications?

Table 4.1.5 Usability professional as a team leader

	Number	Percentage
Yes	32	52%
No	27	44%
Don't know	3	4 %

6. Is a usability professional part of your design and development team?

Table 4.1.6 Design teams which have usability professionals

	Number	Percentage
Yes	15	24%
No	47	76%

7. If your answer to question 6 is no, then tick all that apply for your design and development team members.

Table 4.1.7 Design teams expertise in cognitive psychology

	Number	Percentage
Have knowledge of cognitive psychology	9	19%
Have education in cognitive psychology	7	15%
Have training in cognitive psychology	5	11%
Don't know if any of the team members have knowledge or education or training in cognitive psychology	35	74%

8. Do you think that it is important and necessary for developers to have education and training in cognitive psychology?

Table 4.1.8 Importance of education and training in cognitive psychology for developers

	Number	Percentage
Yes	25	40%
No	28	45%
Don't know	9	15%

9. Do you think that the tertiary education providers in New Zealand for IT qualifications provide a sufficient number of courses and adequate level of coverage for user interface design subjects?

Table 4.1.9 If coverage of user interface design subjects in New Zealand is sufficient

	Number	Percentage
Yes	14	23%
No	10	16%
Don't know	38	61%

10. If your answer to question 9 is no, list what you think should be taught.

The following were listed by respondents as what should be taught for HCI courses:

a) Usability.
b) Human cognition.
c) Accessibility issues.
d) More interaction design courses.
e) How people process information.
f) How people use new technology.
g) End user ability.
h) Graphical user interface design.
i) Functionality design.

11. Do you think our tertiary education providers should provide specialization in user interface design or usability or HCI?

Table 4.1.11 Specialization in user interface design

	Number	Percentage
Yes	35	56%
No	15	24%
Don't know	12	19%

12. Is usability a separate line item in your Web site design project budget?

Table 4.1.12 Usability budget

	Number	Percentage
Yes	13	21%
No	49	79%

13. If your answer to question 12 is no, why not? (Tick all that apply)

Table 4.1.13 Reasons why no separate budget is allocated for usability

	Number	Percentage
Resources are only allocated for design and development of the functionalities of the Web site.	40	82%
Additional funding is not necessary to fix usability issues	5	10%
Developers are skilled and experienced enough to take care of usability issues	21	43%
Don't know	9	18%

14. If usability is a separate line item in your budget, what percentage is the usability budget in relation to the total budget for Web site design and development?

Table 4.1.14 Percentage of fund allocated to usability budget

	Number	Percentage
5% or less.	1	8%
Between 5% to10%.	5	38%
Between 10% to15%.	5	38%
More than 15%.	0	0%
Don't know	2	16%

15. Which of the following do you or your team members regularly read? (Tick all that apply)

Table 4.1.15 Sources for usability related articles

	Number	Percentage
The Net Guide	23	37%
PC Magazine	30	48%
The ACM Communication	2	3%
IEEE	4	6%
Information Systems Research Journal	7	11%
MIS Quarterly Journal	1	2%
None of the above	12	19%
Others	10	16%

16. Have you or any of your design team members read or heard about articles from any of the following people? (Tick all that apply)

Table 4.1.16 Awareness of articles from well known usability specialists and consultants

	Number	Percentage
Jakob Nielsen	34	55%
Aaron Marcus	5	8%
Jarred Spool	8	13%
No response	25	40%

17. What is done by your team to design and develop Web sites that meet the needs of your clients or users? (Tick all that apply)

Table 4.1.17 Tasks undertaken to meet the needs of users

	Number	Percentage
Design based on existing knowledge of the users	40	65%
Do user research	20	32%
Use demographic data obtained from market research	13	21%
Use available staff to represent the target users	25	40%
Design based on business objectives and functions	42	68%
None	2	5%

18. Which of the following methods do you use? (Tick all that apply)

Table 4.1.18 Methods used to collect user data

	Number	Percentage
Individual interview	22	35%
Contextual inquiry (observation of users at work or at home	18	29%
Survey	16	26%
Task analysis	20	32%
Online surveys	9	15%
Focus groups	22	35%
None	11	18%

19. If contextual inquiry is not used, what are the reasons that prevent this technique from being employed? (Tick all that apply)

Table 4.1.19 Reasons why contextual inquiry is not used

	Number	Percentage
Difficulty in identifying the potential users	5	11%
Short time frame	8	18%
Budget constraints	20	45%
Another method is used and is sufficient.	14	32%

20. Which of the following are user characteristics on which your design is based? (Tick all that apply)

Table 4.1.20 User characteristics on which design is based

	Number	Percentage
Intentions	34	55%
Knowledge	37	60%
Skills	28	45%
Experience	28	45%
Context	30	48%
None of these	13	21%

21. Do you categorize users into various user groups?

Table 4.1.21 Creating user groups

	Number	Percentage
Yes	39	63%
No	23	27%

22. If the answer to question 21 was yes, which of the following is used? (Tick all that apply)

Table 4.1.22 Characteristics used to create user groups

	Number	Percentage
Functions of the Web site	24	39%
User roles	25	40%
Users' knowledge and experience	18	29%
Shared similarities	6	10%
Other	2	3%

23. Do you create user profiles?

Table 4.1.23 Creating user profiles

	Number	Percentage
Yes	19	31%
No	43	69%

24. If your answer to question 23 was yes, please list some of the characteristics or features of your user profile.

The respondents who indicated that they create user profiles list the following characteristics of their user profiles:

a) age
b) education
c) access rights
d) user views
e) user roles
f) personalization,
g) account number,
h) address
i) contact number

25. Is user research budget a separate line item in your Web site design project budget?

Table 4.1.25 User research budget

	Number	Percentage
Yes	9	14%
No	53	86%

26. Do you provide personalization within the Web site?

Table 4.1.26 Personalization with Web site

	Number	Percentage
Yes	26	41%
No	36	59%

27. If the answer to question 26 was yes, which of the following do you personalize? (Tick all that apply)

Table 4.1.27 Personalized features

	Number	Percentage
Links	18	69%
Content	25	96%
Authorization	20	77%

28. If the answer to question 26 was no, why not? (Tick all that apply)

Table 4.1.28 Reasons that prevent providing personalization

	Number	Percentage
Knowledge and skills are not sufficient at the moment	7	19%
The cost of providing such a feature is not desirable	9	25%
Not a business goal at the moment to provide for personalization	23	64%
Provide enough options that cater for all types of users	8	22%
Personalization features will be integrated with the Web site in the very near future	1	3%

29. Is it a standard practice for your design team to use an iterative design and development methodology?

Table 4.1.Iterative design and development

	Number	Percentage
Yes	35	56%
No	27	44%

30. If your answer to question 29 is no, why not? (Tick all that apply)

Table 4.1.30 Reasons why iterative design and development method is not used

	Number	Percentage
Design team members are more than capable of making correct design decisions	6	22%
Time consuming	7	26%
Pushes the development cost up	6	22%
Other methodology is more practical	4	15%
No response	9	33%

31. Do you invite users to be part of your Web site design and development team?

Table 4.1.31 User participation in design and development

	Number	Percentage
Yes	28	45%
No	34	55%

32. If your answer to question 31 was yes, tick all that apply.

Table 4.1.32 How users are involved

	Number	Percentage
Users are used to test the initial design decision and final testing of the Web site before it is launched	18	64%
Users take an active part in designing various alternatives and are fully involved in making design decisions	11	39%
Users test and suggest changes at all phases of development and approve modifications before the next phase is started	16	57%
Users are financially compensated for their involvement	6	21%

33. If your answer to question 31 is no, why not? Tick all that apply.

Table 4.1.33 Reasons why users are not involved

	Number	Percentage
User involvement is not necessary	19	59%
Difficult to identify the users of Web sites	2	6%
Users do not have the necessary knowledge and skills to be part of the design team	9	26%
Not practical to involve users to help make design decisions	11	32%
User involvement is seen as a hindrance for Web sites to be developed on time	5	15%

34. Which of the following methods are used? (Tick all that apply)

Table 4.1.34 Methods used to gather design ideas

	Number	Percentage
Brainstorming	20	71%
Storyboarding	7	25%
Workshops	18	64%
Pencil and paper exercises	10	36%
No response	7	11%

35. When do you evaluate the design of the user interface of Web sites?

Table 4.1.35 Evaluation stages

	Number	Percentage
Throughout the design and development process	40	65%
At the end of each design and development phase	9	15%
At the end of the development before the product is released	13	21%

36. Does your design team employ any of the following methods? (Tick all that apply)

Table 4.1.36 Evaluation methods used

	Number	Percentage
Cognitive Walkthrough	11	18%
Heuristic Evaluation	12	19%
GOMS	1	2%
Review Based Evaluation	12	19%
Model Based Evaluation	17	27%
Think Aloud	19	31%
None used	12	19%
Other	1	2%

37. What is the reason for not using Cognitive Walkthrough, Heuristic Evaluation or Think Aloud? (Tick all that apply)

Table 4.1.37 Reasons why discount usability evaluation methods are not used

	Number	Percentage
Not aware of such techniques	21	50%
Do not know the process of how to use any of these techniques.	10	24%
Such techniques do not provide accurate and reliable usability evaluation data.	2	5%

38. Do you consider usability issues for any particular "special" group of users such as elderly users?

Table 4.1.38 Usability issues for elderly users

	Number	Percentage
Yes	24	39%
No	34	61%

39. If your answer to question 38 was yes, tick all that apply.

Table 4.1.39 Usability features for elderly users

	Number	Percentage
Use of appropriate font size	17	71%
Use of static elements	8	33%
Allowing users to change the font size	8	33%
Others: obvious links, colour, short paths to critical information	2	8%

40. If your answer to question 38 was yes, which of the following methods do your design team use to collect user characteristics data about elderly users? (Tick all that apply)

Table 4.1.40 Data collection methods relating to elderly users

	Number	Percentage
Use general literature on aging	10	42%
Surveys	3	13%
Interviews	3	13%
Observation	9	38%
Elderly user involvement in design and evaluation of the Web site	1	4%

41. Do you consider cultural issues?

Table 4.1.41 Cultural consideration

	Number	Percentage
Yes	28	45%
No	34	55%

42. If your answer to question 41 was yes, tick all that apply.

Table 4.1.42 Cultural features

	Number	Percentage
Providing for features that enable users to adjust	9	32%
Use of well researched, appropriate and meaningful metaphors (icons)	18	64%
No response	6	21%

43. Does your organisation have a usability lab?

Table 4.1.43 Usability lab

	Number	Percentage
Yes	1	1%
No	61	99%

44. Do you use real users for testing Web sites for they are launched?

Table 4.1.44 User involvement in testing of Web sites

	Number	Percentage
Yes	32	48%
No	30	52%

45. If your answer to question 45 was yes, tick all that apply.

Table 4.1.45 How users are selected

	Number	Percentage
You select users from representative user groups for testing	31	97%
You use recruitment organizations to select users	2	6%
You provide cash incentives for users who are involved in testing	4	12%

46. Does your design team use any published design guidelines, reference books or manuals when designing user interfaces?

Table 4.1.46 Use of published design guidelines

	Number	Percentage
Yes	20	32%
No	42	68%

47. If your answer to question 46 was yes, what are the published design guidelines, reference books or manuals that are used? (Up to three)

The following answers were provided:

a) Buying reports from Nielson Group

b) New Zealand Government Web site guidelines

c) General literature on accessibility and usability

d) Company-developed guidelines

48. Do you use metaphors (e.g. the Macintosh trash can for deleted files) to represent tasks and functionalities in your design?

Table 4.1.48 The use of metaphors

	Number	Percentage
Yes	19	31%
No	43	69%

49. If your answer to question 48 was yes, how do you ensure that your users understand the metaphors you are using?

The following answers were provided:

a) Design team sorts this out

b) Stick to industry norms

c) Use commonly used ones

d) Introduction of icon, help link

e) Adopted from other sites

50. Do you develop prototypes of Web sites?

Table 4.1.50 Developing prototypes

	Number	Percentage
Yes	38	61%
No	24	39%

51. If your answer to question 50 was no, why not? (Tick all that apply)

Table 4.1.51 Reasons for not developing prototypes

	Number	Percentage
Not important	6	25%
Budget constraints	6	25%
Time constraints	5	21%
No response	7	29%

52. How you rate the usefulness of prototyping?

Table 4.1.52 Usefulness of prototyping

	Number	Percentage
Useful	25	40%
Essential	23	37%
Not so useful	2	3%
Useless	3	4%
No responses	10	16%

53. Which of the following is used if prototypes are to be developed? (Tick all that apply)

Table 4.1.53 Types of prototype

	Number	Percentage
Design on paper	30	48%
Design on computer screen	49	79%

4.2 Results of the Survey done with six major universities

1. What is your job title at your institute?

Table 4.2.1 Participant for the Survey

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Head of School	*					
Head of Department/Section		*	*	*	*	*
Senior Lecturer						
Lecturer						
Head of School						

2. Does your department or section offer courses in Web development?

Table 4.2.2 Courses in Web Development

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes	*	*	*	*	*	*
No						

3. If your answer to question 2 is yes, tick all that apply to your Web development course.

Table 4.2.3 Number of Web courses offered

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Offered as a major		*				
Offered as a minor						
Only a few papers are offered.	*		*	*	*	*

4 Does your department offer papers in usability, user interface design, or human-computer interaction to compliment your Web development courses?

Table 4.2.4 Courses in user interface design or HCI

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes	*	*	*	*	*	*
No						

5. If your answer to question 4 is no, please indicate whether your department plans to offer papers in usability, user interface design, or human-computer interaction in the next few years time.

No response for this question since all the six major universities in New Zealand offer courses in HCI

6. If your answer to question 5 is no, tick all that apply.

The department feels that there is no need to teach such papers as part of the IT curriculum	
The department has not reviewed its current IT courses for a few years	
There is a lack of skilled academics to teach such courses	
The department lacks the funding to have appropriate resources and facilities to teach such courses	

No response for this question since all the six major universities in New Zealand offer courses in HCI

7. Does your department have a usability or human-computer interaction lab?

Table 4.2.7 Usability labs with universities

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes			*	*		*
No	*	*			*	

8. If your answer to question 7 is no, are there any plans to have such a facility in the near future?

Table 4.2.8 Future plan for a usability lab

	Respondent 1	Respondent 2	Respondent 5
Yes			
No	*	*	*
Don't know			

9. Please indicate below the number of usability, user interface design, or Human-Computer Interaction related papers that are offered at the various levels of your IT courses.

Table 4.2.9 Number of HCI papers offered

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
First year	0	0	0	0	0	1
Second year	1	0	0	0	0	1
Third year	2	1	1	2	1	1
Postgraduate level	0	0	1	2	1	1

10. Does your department offer a major or a minor in usability, user interface design, or human-computer interaction?

Table 4.2.10 HCI specialization

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes						
No	*	*	*	*	*	*

11. If your answer to question 10 is no, are there any plans to offer a major or a minor in this discipline in the near future?

Table 4.2.11 Future plans for HCI courses offered as a major or minor study

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes						
No	*	*	*	*	*	*
Don't know						

12. If your answer to question 11 is no, tick all that apply.

Table 4.2 Reasons why in future HCI will not be offered as a major or minor study

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
The department feels that there is no need to offer a major or a minor in usability, user interface design or human-computer interaction.	*	*	*	No response		
There is no indication from industry or the business sector that there is a need for usability graduates		*		No response		
The department has not reviewed its current IT courses for a few years				No response		
There is a lack of academics to teach papers in this area				No response		
The department lacks the funding to have appropriate facilities and resources	*		*	No response	*	
Other reasons						Don't have specialist majors

13. Please indicate the total number of academic staff in your department and the number who could teach usability, user interface design or human-computer interaction papers.

Table 4.2.13 Number of HCI academic staff

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Total Number of academic staff in your department	33	40	30	30	16	15
Total Number of academic staff in your department who can teach HCI	3	5	4	3	6	4

14. Of the total number of academic staff who could teach usability, user interface design or human-computer interaction papers, please indicate below the number who have specific qualifications in usability, user interface design or human-computer interaction. (Tick all that apply).

Table 4.2.14 Number of Academic staff with HCI qualifications

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Degree	No response	0	0	1	0	0
Postgraduate	No response	0	0	0	0	0
Masters	No response	0	0	1	0	0
Ph D	No response	0	4	1	2	2

15. Please indicate below the number of students in your department who are doing postgraduate research projects, masters, or doctoral theses relating to usability, human-computer interaction, or user interface design.

Table 4.2.15 Number of students doing postgraduate projects or thesis in HCI

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Postgraduate research project	2	0	2	3	3	3
Masters thesis	1	0	2	3	3	3
Doctoral thesis		0	3	4	1	2
Don't Know						

16. Do you have staff members who publish research papers relating to usability, human-computer interaction or user interface design?

Table 4.2.16 Academic staff involved in HCI research

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes	*		*	*	*	*
No		*				

17. Do you have staff members who attend seminars or conferences relating to usability, Human-Computer Interaction or user interface design?

Table 4.2.17 HCI conference

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes	*		*	*	*	*
No		*				

18. Do your students doing an IT course usually take one or more cognitive psychology papers?

Table 4.2.18 Cognitive psychology papers for IT course

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes						
No	*	*	*	*	*	*

19. Do you believe that students taking an IT course who take cognitive psychology papers are more likely to better understand usability issues?

Table 4.2.19 Importance of cognitive psychology

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Yes	*	*	*	*	*	*
No						

4.3 HCI courses with overseas universities

ACM SIGCHI Curricula for Human-Computer Interaction.

Source: (www.hcibib.org/education)

Table 4.3.1 shows that the proposed framework for the computer science programme consisted of the following:

1. General education requirements
2. Computer science core requirements
3. Requirements for HCI specialization
4. Electives

1. General Education Requirements

			Courses	Terms		IT qualifications with New Zealand universities
1.	Natural Science Terms: 2 minimum, 2 recommended, 4 maximum.	1	Physics	2	Strongly recommended	Not required
		2	Chemistry	2	Recommended	Not required
		3	Perception and Psychophysics	2	Recommended	Not required
2	Mathematics Terms: 2 minimum, 2 recommended, 4 maximum.	1	Calculus/Analysis	2	Required	Offered by most universities
3	Behavioural Science Terms: 2 minimum, 2 recommended, 2 maximum.	1	Introduction to Psychology	1-2	Strongly recommended	Not required
		2	Introduction to Sociology	1-2	Strongly recommended	Not required
4	Humanities	1	Effective Writing and Speaking	2	Strongly recommended	Required by most universities
		2	Technical Writing	2	Strongly recommended	Required by most universities
		3	Philosophy	2	Recommended	Not required
		4	Other (Literature, Political, History)	2	Recommended	Not offered

2. Computer science core requirements

			Courses	Terms		IT qualifications with New Zealand universities
1.	Mathematics Terms: 1 minimum, 2 recommended, 4 maximum.	1	Discrete Maths/Algebra	1	Required	Not required
		2	Discrete Maths for Computer Science	1	Strongly recommended	Not required
		3	Mathematical Logic	1	Recommended	Not required
2	Computer Science Terms: 8 minimum, 8 recommended, 10 maximum.	1	Introduction to Computer Science	1-2	Required	Required by most universities
		2	Computer Organization/Architecture	1	Required	Required by most universities
		3	File Structures and Data Management	1	Required	Required by most universities
		4	Programming Languages	1	Required	Required by most universities
		5	Information Structure	1	Required	Required by most universities
		6	Software Engineering	1	Required	Required by most universities
		7	Operating Systems	1	Strongly recommended	Required by most universities
		8	Automated Theory & Formal Languages	1	Strongly recommended	Not known
		9	Ethics in Computer science	1	Strongly recommended	Not known
		10	Computability and Complexity	1	Recommended	Not known

3. Requirements for Human-Computer Interaction Specialization

			Courses	Terms		IT qualifications with New Zealand universities **(No HCI specialization)**
1.	Human-Computer Interaction Terms: 3 minimum, 4 recommended, 5 maximum.	1	User Interface Design and Development	1	Required	Not required
		2	Phenomena and Theories of Human-Computer Interaction	1	Required	Not required
		3	Senior Design Project or Thesis	1-2	Strongly Recommended	Not required
		4	Human Factors	1	Recommended	Not required
		5	Cognitive Engineering	1	Recommended	Not required
2	Computer Science Electives Terms: 1 minimum, 1 recommended, 2 maximum.	1	Introduction to Computer Science	1	Strongly Recommended	Required by most universities
		2	Artificial Intelligence	1	Strongly Recommended	Required by most universities
		3	Information Systems Analysis and Design	1	Strongly Recommended	Required by most universities
		4	Database Management/ Information Retrieval	1	A reasonable choice	Required by most universities
		5	Systems Engineering	1	Recommended	Not known
		6	Software Engineering	1	Required	Required by most universities
3.	Psychology and Cognitive Science Terms: 3 minimum, 4 recommended, 6 maximum.	1	Introduction to Psychology	1-2	Required	Not required
		2	Statistics (applied)	1	Required/Strongly recommended	Not required
		3	The Design of Experiments	1	Required/Strongly recommended	Not required
		4	Human Information Processing/Performance	1	Strongly recommended	Not required
		5	Social Psychology	1	Strongly recommended	Not required
		6	Sensation and Perception	1	Strongly recommended	Not required
4	Social Science Terms: 3 minimum, 3 recommended,	1	Introduction to Sociology	1-2	Required	Not required
		2	Social Science Research Methods	1	Required/Strongly	Not required

	5 maximum.				recommended	
		3	Sociology of Organizations or Organizational Behaviour	1	Strongly recommended	Not required
		4	Social Psychology	1	Strongly recommended	Not offered
5	Media and Design Terms: 2 minimum, 2 recommended, 4 maximum.	1	Graphic and/or Information Design	1	Required	Not required
		2	Visual Thinking	1	Strongly recommended	Not required
		3	Hypermedia/Interactive Media Design	1	Recommended	Not required
		4	Film Making	1	A reasonable choice	Not required
		5	Video Design and Production	1	A reasonable choice	Not required
		6	Animation	1	A reasonable choice	Not required
		7	Industrial Design	1	A reasonable choice	Not required

4. Electives

					A reasonable choice	IT qualifications with New Zealand universities
1	Terms: 4 minimum, 8 recommended, 12 maximum.	1	Introduction to Business	1	A reasonable choice	Not required
		2	Financial Accounting	1	Recommended	Not required
		3	Innovation and Entrepreneurship	1	Recommended	Not required
		4	Software/Business Law	1		Not required
		5	Other Electives			Required

Table 4.3.2 shows that the proposed framework for the information systems programme consisted of the following:

1. General education
2. Management system core requirement
3. Requirements for HCI specialization
4. Electives

1. General Education Requirements

			Courses	Terms		IT qualifications with New Zealand universities
1.	Natural Science Terms: 2 minimum, 2 recommended, 2 maximum.	1	Physics	2	A reasonable choice	Not required
		2	Chemistry	2	A reasonable choice	Not required
		3	Biology	2	A reasonable choice	Not required
2	Mathematics Terms: 2 minimum, 2 recommended, 2 maximum.	1	Collage Algebra	2	A reasonable choice	Not required
		2	Introductory Calculus	2	A reasonable choice	Not required
3	Behavioural Science Terms: 2 minimum, 2 recommended, 2 maximum.	1	Introduction to Psychology	1-2	Strongly recommended	Not required
		2	Introduction to Sociology	1-2	Strongly recommended	Not required
		3	Introduction to Anthropology	2	A reasonable choice	Not required
4	English, speech, and oral communication Terms: 2 minimum, 2 recommended, 2 maximum.	1	Composition & Rhetoric	2	Strongly recommended	Not required
		2	Effective Speech	1	Strongly recommended	Not required
		3	Speech for Business and Professional	1	Recommended	Not required
5	Other humanities Terms: 2 minimum, 2 recommended, 3 maximum.	1	Sequence in Literature or Philosophy	2	Recommended	Not required
		2	Sequence in History, Government, or Politics	2	Strongly recommended	Not required
		3	Sequence in a Foreign Language	2	Recommended	Not required

2. Management Information systems core requirements

			Courses	Terms		IT qualifications with New Zealand universities
1.	Business Terms: 10 minimum, 11 recommended, 14 maximum.	1	Introduction to Accounting	2	Required	Required
		2	Introduction to Economics	1-2	Required	Required
		3	Statistics & Research Design (Applied Statistics)	1-2	Required	Not required
		4	Marketing	1	Required	Not required
		5	Organizational Behaviour	1	Required	Not required
		6	Legal Environment of Business	1	Required	Not required
		7	Business Policy	1	Required	Not required
		8	Financial Management	1	Strongly recommended	Not required
		9	Production/Operations Management	1	Strongly recommended	Not required
		10	Business communications	1	Strongly recommended	Not required
		11	Managerial Economics	1	Recommended	Not required
2	Information Systems Terms: 7 minimum, 8 recommended, 10 maximum.	1	Computer Concepts and Software Systems	1	Required	Required
		2	Program, Data, and File Structures	1	Required	Not required
		3	Database Management Systems	1	Required	Required
		4	Data communication System and Networks	1	Strongly recommended	Required
		5	Information Systems in Organization	1	Required	Required
		6	Information Analysis	1	Required	Required
		7	System Design Process	1	Required	Required
		8	Information Systems Projects	1	Strongly recommended	Not required

3. Requirements for Human-Computer Interaction Specialization

			Courses	Terms		IT qualifications with New Zealand universities (No HCI specialization)
1.	Human-Computer Interaction Terms: 2 minimum, 3 recommended, 3 maximum.	1	Human Aspects of Information Systems	1-2	Required	Not required
		2	Human-Computer Interaction Project	1	Strongly Recommended	Not required
		3	Special topics: e.g. CSCW	1	Recommended	Not required
2	Information System and Computer Science Electives Terms: 1 minimum, 2 recommended, 2 maximum.	1	Software Engineering	1	Strongly Recommended	Not required
		2	Artificial Intelligence	1	Strongly Recommended	Not required
		3	Computer Graphics	1	A reasonable choice	Not required
3.	Psychology and Cognitive Science Terms: 1 minimum, 2 recommended, 2 maximum.	1	Human Information Processing/Performance	1	Strongly Recommended	Not required
		2	Cognitive Psychology/Cognitive Science	1	Strongly Recommended	Not required
4	Social Science Terms: 1 minimum, 1 recommended, 2 maximum.	1	Social Psychology	1	Recommended	Not required
		2	Sociology of Organizations	1	Recommended	Not required
		3	Introduction to Ethnography	1	Recommended	Not required

4. Electives

1	Terms: 2 minimum, 4 recommended, 6 maximum.	1	Ethics in Computing	1	Strongly recommended	Not required
		2	Animation	1	Recommended	Not required
		3	Graphic Design	1	Recommended	Not required
		4	Hypermedia	1	Recommended	Not required
		5	Technical Writing	1	Recommended	Not required
		6	Industrial Design	1	A reasonable choice	Not required

Table 4.3.3 below shows universities worldwide that offer major or minor study in human-computer interaction. Data for Table 4.3.3 was compiled from http://www.hcibib.org/education/

	Country	Number	University
1	Australia	1	University of Queensland
		2	University of Melbourne
		3	Swinburne University of Technology
		4	University of Western Australia,
2	Austria	1	Graz University of Technology
3	Canada	1	University of Calgary
		2	University of British Columbia
4	Denmark	1	University of Southern Denmark
5	Finland	1	University of Tampere
6	Germany	1	University of Oldenburg
7	Italy	1	Interaction Design Institute Ivrea
8	Netherlands	1	Eindhoven University of Technology
9	Sweden	1	Linkoping University
10	United Kingdom	1	University of Bath
		2	De Montfort University
		3	London Guildhall University
		4	Middlesex University
		5	University College London
		6	University of Dundee
		7	Heriot-Watt University
11	United States	1	University of California
		2	University of Southern California
		3	Stanford University
		4	University of California
		5	University of Colorado
		6	Nova Southeastern University
		7	Georgia Institute of Technology
		8	Columbia College
		9	DePaul University
		10	Indiana University
		11	Purdue University
		12	Iowa State University
		13	Maharishi University of Management
		14	University of Maryland Baltimore County
		15	University of Maryland at College Park
		16	MIT Media Lab
		17	University of Massachusetts
		18	Tufts University
		19	Bentley College
		20	University of Michigan
		21	Minneapolis College of Art and Design
		22	University of Nebraska
		23	Cornell University
		24	Rensselaer Polytechnic Institute
		25	University of North Carolina
		26	Kent State University
		27	University of Oregon
		28	Drexel University
		29	Carnegie Mellon University
		30	Rice University
		31	Virginia Tech
		32	University of Virginia
		33	George Mason University
		34	University of Washington
12	New Zealand	None	

Table 4.3.4 shows Human-Computer Interaction Labs associated with Universities Worldwide. Data for Table 4.3.4 was compiled from http://www.hcibib.org/education/ .

Table 4.3.4

	Country		Name of Laboratory	University
1	Australia	1	Swinburne Computer Human Interaction Laboratory (SCHIL)	Swinburne University
		2	Research Centre for Information Technology	University of Canberra
		3	Interaction Design Group	University of Melbourne
		4	Intelligent Systems	University of South Australia
		5	Cognitive Engineering Research Group (CERG)	The University of Queensland
2	Austria	1	User Interface Group	University of Vienna
		2	HCI	Vienna University of Technology
3	Belgium	1	Belgian Laboratory of Computer-Human Interaction (BCHI	Universite Catholique de Louvain
		2	Computer Science Department	University of Namur
4	Canada	1	Human Oriented Technology Lab (HOT Lab)	Carleton University
		2	Human Media Lab	Queen's University
		3	Virtual Hand Laboratory	University of British Columbia
		4	Grouplab: Computer-Supported Cooperative Work and Groupware Research Laboratory	University of Calgary
		5	HCI Lab	University of New Brunswick
		6	University Of Saskatchewan HCI Lab	University Of Saskatchewan
		7	Interactive Media Lab (IML)	University of Toronto
		8	Input Research Group	University of Toronto
		9	HCI + TeleLearning	University of Waterloo
5	Denmark	1	Systems Engineering and Human-Machine Systems	University of Kassel
		2	Computer Graphics and HCI	University of Oldenburg
6	Finland	1	Usability Group	Helsinki University of Technology
		2	TAUCHI group	University of Tampere
		3	Research in Human-Computer Interaction	University of Tampere
7	France	1	Laboratory of Applied Computer Science	Poitiers National School of Engineers in Mechanics and Aerotechnics
		2	HCI Group at CLIPS-IMAG Laboratory	University of Grenoble
		3	Groupe Interaction Homme-Machine	University of Paris-Sud
		4	Laboratory for Interaction between Human and Systems	University of Toulouse
		5	Group Interaction Homme-Machine (Man-Machine)	University of Paris
8	Germany	1	Centre for Human-Machine-Interaction	Universitat Kaiserslautern
9	Greece	1	University of Patras HCI Group	University of Patras
		2	HCI Greece	University of Patras
10	Ireland	1	Interaction Design Centre	University of Limerick
11	Italy	1	HCI Lab	University of Udine
12	Japan	1	HCI Laboratory	Toyohashi University of Technology
13	Korea	1	HCI Laboratory	Pohang University of Science and Technology
14	Netherlands	1	Groupware Task Analysis	Vrije Universiteit
15	New Zealand	1	Human Interface Technology Laboratory New Zealand	Canterbury University
16	Norway	1	HCI Sidene hos NTNU	Norwegian University of Science and Technology
17	Sweden	1	Cognition Technology Working Group	Chalmers University of Technology
		2	Usability Matters	Linkoping University
		3	SSKKII	Sweden Goteborg University (GU)

				and Chalmers Institute of Technology (CTH)
		4	Centre for Human-Computer Studies	Uppsala University
		5	Department of Human-Computer Interaction	Uppsala University
		6	Division of HCI	Uppsala University
18	Switzerland	1	Laboratory of Ergonomics of Intelligent Systems and Design (ErgoIS Design)	Swiss Federal Institute of Technology
19	United Kingdom	1	Human Computer Interaction Lab	Binghamton Universities
		2	Usability Laboratory for Digital Media Design	Birmingham Institute of Art and Design
		3	Interaction Design Research	Brunel University
		4	MRC Applied Psychology Unit	Cambridge University
		5	Centre for HCI Design	City University London
		6	Department of Applied	Computing University of Dundee
		7	Interactive Systems Group (GIST)	Glasgow University
		8	Interactive Media Research Group	Heriot-Watt University
		9	HCI Group	Imperial College
		10	Centre for HCI Design	London City University
		11	HCI Group	Napier University
		12	Intelligent Interfaces Special Interest Group (IISIG)	Open University
		13	Human Computer Interaction Research Group	Queen Mary and Westfield College University of London
		14	Centre for People and Systems Interaction	South Bank University
		15	Ergonomics and HCI Unit	University College London
		16	Advanced Interaction Group	University of Birmingham
		17	Digital Interactive Media Group	University of Brighton
		18	Child Computer Interaction Group	University of Central Lancashire
		19	Sensory Disabilities Research Unit (SDRU)	University of Hertfordshire
		20	HCI Research Centre	University of Huddersfield
		21	Virtual Environments, Graphics and Applications (VEGA)	University of Hull
		22	Workgroup on Graphical Programming and Intelligent User Interfaces	University of Leeds
		23	Advanced Interfaces Group	University of Manchester
		24	Communications Research Group	University of Nottingham
		25	Human-Centred Technology group	University of Sussex
		26	Human Computer Interaction and Computer Based Learning	University of York
		27	HUSAT Research Institute	Loughborough University
20	United States	1	Computer Graphics Group	Brown University
		2	Human-Computer Interaction Institute (HCII)	Carnegie Mellon University
		3	Computer Graphics and User Interfaces Lab	Columbia University
		4	Centre for Human-Machine Systems Research (CHMSR)	Georgia Tech
		5	Graphics, Visualization & Usability Center (GVU)	Georgia Tech
		6	IU HCI Lab	Indiana University
		7	Media Interface and Network Design Lab	Michigan State University
		8	Adaptive Computing Lab	Millersville University
		9	NYU Interactive Telecommunications Program	New York University
		10	Cognitive Systems Engineering Laboratory	Ohio State University
		11	Interactive Systems Research Group	Oregon Graduate Institute
		12	Centre for Human Computer Communication	Oregon Graduate Institute of Science and Technology

		13	Human-Computer Interaction Design	Stanford University
		14	Distributed Cognition and HCI Lab	University of California
		15	UC Berkeley Digital Library Project	University of California
		16	Group for User Interface Research	University of California
		17	Alexandria Digital Library	University of California
		18	Centre for Lifelong Learning and Design	University of Colorado
		19	Human-Computer Cooperative Problem Solving Lab	University of Illinois
		20	Interactive Computing Environments (ICE) Laboratory	University of Illinois
		21	University of Illinois Digital Libraries Initiative	University of Illinois
		22	Human-Computer Interaction Group	University of Illinois
		23	Communication and Technology Working Group	University of Kansas
		24	Human-Computer Interaction	University of Maryland
		25	Laboratory for Automation Psychology	University of Maryland
		26	Collaboratory for Research on Electronic Work	University of Michigan
		27	Digital Library Project	University of Michigan
		28	Human-Computer Interaction Research	University of Nebraska-Lincoln
		29	Computer Science Research	University of North Carolina
		30	Interaction Design	University of North Carolina
		31	Human Technology Interaction Centre	University of Oklahoma
		32	Interactive Systems Group (HCI)	University of Oregon
		33	Interactive Systems	University of Texas
		34	Human-Computer Interaction	University of Virginia
		35	Human Interface Technology Lab	University of Washington
		36	HCI Laboratory	Virginia Tech
		37	MIT Laboratory for Computer Science	MIT
		38	Institute of Design, IIT	Chicago Institute of Design

Table 4.3.5 shows Human-Computer Interaction or usability labs associated with Government departments, with large corporations and business organizations worldwide. Data for Table 4.3.5 was compiled from http://www.hcibib.org/ .

	Country		Name of Lab	Owner
1	Canada	1	NRC Interacting with Modelled Environments Group (IME)	National Research Council IIT
2	Denmark	1	Danish English Userminds	Danish English Userminds
3	France	1	European Institute of Cognitive Sciences and Engineering	European Institute of Cognitive Sciences and Engineering
4	Germany	1	Interactive Systems Lab	Interactive Systems Lab
		2	German Dresdner Usability	German Dresdner Usability
		3	Scoreberlin - Strategic Consulting, Research & Evaluation	Scoreberlin - Strategic Consulting, Research & Evaluation
5	Ireland	1	Human Factors Research Group	HFRG
6	Japan	1	Sony Computer Science Laboratory	Sony
7	Netherlands,	1	Centre for Research on User-System Interaction	Centre for Research on User-System Interaction
8	Norway	1	Usability Laboratory	SINTEF
9	South Africa	1	iLAB Project Services	Sandton Company
10	United Kingdom	1	NPL Usability Services	National Physical Laboratory
		2	British Telecom Research and Development	British Telecom
11	United States	1	Microsoft User Interface Research Group	Microsoft Cooperation
		2	Liquid Information Organization	Liquid Information Organization
		3	NCR Human Interface Technology Center	NCR
		4	OCLC Human-Computer Interaction	Worldwide Library Cooperative
		5	Xcelerate Corporation	Xcelerate Corporation
		6	Apple HI	Apple Computers
		7	Human Systems Information Analysis Center	Human Systems Information Analysis Center
		8	Inter-Language Unification Xerox PARC	Xerox
		9	Pliant Research	Pliant Research
		10	IBM Almaden Research Center	IBM
		11	CHIC Computer Human Interaction	CHIC
		12	Bay Area Usability Testing Lab - Interface Analysis Associations	Bay Area Usability Testing
		13	NSF Information and Intelligent Systems Division	Washington National Science Foundation
		14	HCI at the Rockwell Science Center	Rockwell Scientific
		15	NASA Ames Human-Automation Integration	United States Government
		16	NRL Interface Design and Evaluation Section (Code 5513)	Naval Research Laboratory
		17	NSF Human Computer Interaction Program	NSF
		18	SurgeWorks Human Factors & Usability Engineering	SurgeWorks Human Factors & Usability Engineering
12	New Zealand	None		

Table 4.3.6 shows the major Human-Computer Interaction or usability conferences. Data for Table 4.3.6 was compiled from http://www.hcibib.org/ .

	Name of conference	When started	When it happens	Sponsor
1	CSCW: Computer-Supported Cooperative Work (Conference)	1986	Semi-annual conference Alternates with the European CSCW conference	ACM SIGCHI and SIGGROUP
2	HT: Hypertext (Conference)	1987	Annual conference	SIGCHI, SIGWEB, SIGGROUP, and SIGIR
3	DIS: Designing Interactive Systems (Conference)	1995	Semi-annual conference.	ACM SIGCHI
4	IUI: Intelligent User Interfaces (Conference)	1993	Annual conference	ACM SIGCHI and SIGART
5	UIST: User Interface Software Technology (Conference)	1986	Annual conference	Sponsored by ACM SIGCHI and SIGGRAPH
6	CC: Creativity and Cognition (Conference)	1999	Annual conference	ACM SIGCHI
7	CHI: Human Factors in Computing Systems (Conference)	1982	Annual conference	ACM SIGCHI
8	MM: ACM Conference on Multimedia SIGCHI SIGGRAPH	1993	Annual conference	SIGCHI SIGGRAPH
9	HFES: Human Factors and Ergonomics Society Annual	1957	Annual conference	Not known
10	OZCHI: Australian Computer-Human Interaction (Conference)	1991	Annual conference	Not known
11	HCII: HCI International 1985	1995	Held in conjunction with other conferences, such as: Symposium on Human Interface (Japan) International Conference on Engineering Psychology & Cognitive Ergonomics International Conference on Universal Access in Human-Computer Interaction	Not known
12	IFIP: Conference on Human-Computer Interaction	1984	Every two years	Not Known
13	UPA: Usability Professionals Association (Conference))	1997	Annual	Not Known
14	GI: Graphics Interface (Conference)	1969	Annual conference	
15	GROUP: ACM SIGGROUP Conference on Supporting Group Work	1984	Annual conference	ACM SIGGROUP
16	CADUI: Computer-Aided Design of User Interfaces (Conference)	2003		
17	ASSETS: ACM SIGCAPH Conference on Assistive Technologies	1994	Annual conference	SIGCAPH ACM

Chapter 5

5. Discussion

5.1 Discussion of results of the survey done in the industry

5.1.1 Participant for the Survey

For the industry survey, the majority of the participants were developers (58%) while a few of them were managers (32%). No usability Engineers completed the survey.

5.1.2 Important design factors for Web sites

An overwhelming majority of the respondents indicated that the success of Web sites depends upon the content it provides (95%) and the ability to easily locate information by users (98%). Up to date information on Web sites and an indication of when the information was updated is key to attracting surfers and users to the site on a regularly basis. A Web site should always give a clear indication to the users and surfers when and how frequently any information is updated within the Web site.

Easy navigation was rated by a significant majority (81%) of the respondents as critical for the success of Web sites, which is another very important factor in determining usability, i.e. how easy it is for surfers and users to use the Web site. The ability to move around within the Web site without any delay and confusion is very important if the site is an ecommerce site. Nielsen (2000) says that if the users can't find it they will never buy it. Navigation features should always be easy to locate and use, allow users to easily move back and forward within the Web site, enable the users to know where they are within the site at any given point of time, and also allow the users to leave the site whenever they wish to do so with ease. This feature should always be a prime consideration with designers and developers of Web sites.

A majority of the respondents (74%) also rated easy download as critical to the success of Web sites. It is well known that any delay in downloads will cause frustration, and users will simply leave. Nielsen (2000) strongly argues that any download delay which is more that 10 seconds will make users leave the site, and they may never come back. This is another critical issue that all designers and developers have to keep in mind at all times.

Only a significant minority of the respondents (48%) indicated that functionality is critical to the success of any Web site. This result is a cause of concern since one of the ways to achieve usability is by ensuring all the appropriate and required functions are provided, so that the users are able to successfully complete tasks. The functions of the Web site have to be determined, designed and developed based on a user study and user evaluation. Web sites should always have meaningful tasks which the users are able to relate to. The ability to provide all the necessary functionalities should be at the top of the agenda. Designers and developers should know the process that is involved to determine, design, develop, and test the functionalities of Web sites so that they will meet the needs and requirements of target audiences.

A majority of the respondents (53%) indicated that aesthetics is also crucial to the success of Web sites. According to Karvonen (2000), "simplicity", "design quality", and "pleasantness" are all aesthetic notions, and if developers and designers pay serious attention to aesthetics it enable them to research what will work and what will cause problems for users when using different colours and graphics to enhance the quality and presentation of information that the Web site provides for its users. According to Wright et al. (2001), knowledge of aesthetics enables designers of Web sites to use colours that are consistent and clear, which results in designing a Web interface that is more learnable and usable for users. Designers and developers should have knowledge and understanding in aesthetics since current Web site design and development is so much driven by technology, which enables the developers to easily incorporate colours and graphics within the Web site to make it look very attractive, but which may also create various usability problems.

Developers and designers also need to understand that they should not over-emphasise aesthetics so much that the usability of the site is degraded. According to Tractinsky (1997) aesthetics may not always coincide with usability, and in fact the opposite might occur. Tractinsky says that the contribution of aesthetics to HCI should be measured in terms of facilitating information processing, not in terms of engaging the user in a pleasing experience.

While the majority (53%) of the respondents indicated that the use of appropriate graphics will determine the success of Web sites, it was expected that the use of this practice would be rate by most of the respondents. Designers and developers should be made aware that the use of appropriate graphics significantly enhances the presentation of information and also makes the information easier to interpret. Whatever graphics are chosen to be implemented in Web sites have to be meaningful, and something which the users are able to relate to. The designers must also be able to judge the appropriate level of usage of graphics whereby the performance of the site is not downgraded.

Only a few of the respondents (4%) listed other factors such as easily maintainable information and compliance with New Zealand Government standardization as important in determining the success of Web sites. It is interesting to note that respondents failed to list other critical issues such as ensuring their users and browsers that the Web site is a trustworthy site, providing a means for the users to give feedback about the site and clearly show whom to contact, with an email address and phone number, in case of any inquiry about the product or service that is offered via the Web site.

It was expected that all of these design factors were to be highly rated by all of the respondents but it was not case. It appears that people who are involved in the design, development and management of Web sites in New Zealand are not aware of all the critical usability issues involved in designing and developing Web sites. The critical design factors for Web sites such as: (a) the content it provides, (b) the ability to easily locate information within the site, (c) easy navigation and downloads, (d) functionalities of the Web site, (d) aesthetics, (e) the use of appropriate graphics, (f) providing a means for users to give feedback about the site, and (g) showing relevant information that makes users confident that the site is a creditable site, should be mantra of any Web site designer or developer.

5.1.3 Usability professional as part of design team

A significant majority of the respondents (76%) think that usability professionals should be part of the design and development team while a few of the respondents (19%) believe that usability professionals should not be part of the design and development of the user interface. Seventy six percent is a significant number which indicates that the issue of usability for Web sites and Web-based products can be institutionalized in New Zealand. According to Nielsen (2002b), the usability of non-U.S. e-commerce sites is three years behind the usability of U.S. sites since usability is a prime consideration in the U.S. due to executive management emphasis on usability. A study done by Grudin and Poltrock (1998) reveals that there is an overall lack of management understanding and support for human factors. If usability is to be institutionalised in New Zealand with companies and organizations then the management of businesses and organizations should be informed that only useable Web sites and Web-based applications will provide a strategic advantage in the competitive global marketplace.

If local organizations and companies decide to foster and invest in usability then usability professionals can be trained. Usability specialists are highly trained professionals with knowledge of interaction theory, user-research methodologies, user testing, and evaluation methodologies. This kind of knowledge and education is not usually part of the education of developers.

Usability specialists learn communication skills which enable them to effectively communicate both formally and informally with various levels of people, which provide a significant understanding of what will or will not work for the target audience. According to Karat and Dayton (1995), usability specialists are highly skilled people who have a broad range of mostly social, organisational, artefact-design skills and with practical experience in activities of usability engineering that are important for interface design.

The idea of having a usability specialist is also strongly advocated by Myers (1994) who says that the developers designing user interfaces should involve trained user interface specialists, since they have proven to significantly improve the interface and have been cost effective.

5.1.4 Reasons for non-inclusion of usability professional in a design team

A significant majority of the respondents (75%) feel that the usability professionals should not be part of the design team since the clients are not willing to pay extra for usability evaluation and assume that the developers will take care of usability issues in Web sites. It shows that the business community in New Zealand has very little knowledge that usability issues need to be thoroughly dealt with if Web sites are to provide any strategic advantages.

According to Nielsen (2003b), there is a misconception about the expense of usability, the time it involves, and its creative impact, that prevents companies from getting crucial user data, as does the erroneous belief that existing customer-feedback methods are a valid driver for interface design. Nielsen says that even a small company's Web site can be enormously benefited by integrating usability practices and processes into the design process and a small budget set aside for usability will substantially improve a Web site's business value. According to Nielsen (2003a), professionally run design agencies user test their designs to increase the value they deliver to their clients, and he says that there is a challenge to get the clients to understand the benefits that usability testing will bring. According to him the only way to get the clients to pay for usability evaluation and for using effective processes to design and develop Web sites is to educate and point out the usability's "amazing" return on investment.

A majority of the respondents (67%) think that developers have enough knowledge, skills, and experience to take care of usability issues in Web sites and Web-based applications. But the biggest drawback in New Zealand is that the majority of the IT graduates lack sufficient and appropriate education in HCI, hence usability issues are not thoroughly considered when Web sites are developed (Table 4.2.9, Table 4.2.10 and 4.2.18). If developers in New Zealand are also to take care of the usability issues then HCI courses together with cognitive psychology and sociology courses should be compulsory for undergraduate computer science and information systems degree programmes. According to Howard (1995), the knowledge of psychological foundations of users is required if usable interfaces are to be designed. According to Myers (1994), it is very important for user interface design to be part of programmers' education since the programmers need to understand that HCI design is a valued field where special training is required to create high-quality user interfaces. In New Zealand, it appears that it is the Web developer, who does all the tasks alone including designing, developing, testing, and implementing the user interface of Web sites.

A majority of the respondents (58%) think that the development cost would go up if usability professionals were to be part of the design and development team. But the financial return for having a usable site would be far bigger in the long term than the cost of the development. Nielsen (2001) strongly states that poor usability has closed many e-commerce sites and has also dramatically downscaled many Web sites. It is usability specialists that enable usable sites to be designed and it this important that every one involved with Web site design and development is made aware of this including the Web site owners.

A few of the respondents (25%) think that usability professionals would be a hindrance to quick design decisions. There appears to be lack of knowledge amongst these people regarding the roles and types of skills that usability professional possess, and what benefits the usability professional will bring to overall Web site and Web-based application design and development.

It also appears that Information Technology curricula in New Zealand tertiary institutes do not place a high value on HCI courses since no major or minor study is offered in HCI and for the majority of universities, the HCI courses are not a requirement for computer science or information systems degree qualifications – in most cases it is left to the students to decide if they want to do a course in HCI. New Zealand universities are well regarded in producing Information Technology graduates but these graduates lack a thorough education in HCI. The survey of six major New Zealand universities revealed that most of these universities only offer one or two courses in HCI (Table 4.2.9) in the degree programmes for computer science or information systems qualifications.

A few of the respondents (8%) think that usability professionals will not fit in with the short time period of Web development and will delay the completion of the Web site. But usability professionals have knowledge and skills that will always ensure that alternative designs are developed based on user studies and a thorough evaluation of the proposed designs are carried out, that may also involve the target audiences, before any decision is made on which one be developed into a working product. Their involvement may expand the development time but they ensure the product that is designed and developed will meet the needs and requirements of the target audiences. Usability professionals are trained to do the necessary ground work such as a user study that provides solid foundations for various alternative designs, which are evaluated to decide what will or will not work for the target audience.

5.1.5 Usability professional as a team leader

The majority of the respondents (52%) believe that usability professionals should lead the way in designing the user interface of Web sites or Web-based applications, while a minority of the respondents (44%) believe the opposite. This result (52%) when compared to the seventy six percent result in Table 4.1.3 i.e. those who said that usability professionals should be part of the design and development team, shows that in New Zealand there is a lack of knowledge of the roles, skills, duties and responsibilities of usability professionals.

While the fifty two percent results can be interpreted as encouraging, it is becoming clear that there is a need in New Zealand to inform all the stakeholders that the involvement of usability professionals will bring an astounding return in investment in Web sites and will make Web sites more effective by ensuring that sound processes and techniques are used to design and develop Web sites based on user research and not on assumptions about the target audiences.

5.1.6 Design teams which have usability professionals

A significant minority of the respondents (24%) indicated that a usability professional is part of their design and development team. This is a surprising result since it was expected that nearly all respondents would indicate that a usability professional is not part of their design and development team. The six major New Zealand universities (Table 4.2.10) do not offer a major or minor study in HCI for undergraduate Information Technology degree programs and it was not inquired where these usability professionals came from and if they had any relevant tertiary qualifications in HCI.

The growth of the World Wide Web and the Internet in the last 10 to 15 years has caused many universities in developed countries (especially in the U.S., U. K., Australia, and in most of the European countries) to significantly increase their coverage of HCI, and offer a major and minor study in HCI as part of their Information Technology undergraduate degree programs. It appears that the majority of New Zealand Web sites may fail in usability tests when compared to the competing Web sites from U.S., U.K., and Australia since the design and development of New Zealand Web sites did not involve any usability professionals.

5.1.7 Design teams expertise in cognitive psychology

Those respondents that indicated that they do not have usability professionals as part of their design and development team, only a few of them have team members who have knowledge (19%), education (15%), and training (11%) in cognitive psychology. These results further suggest that a very large number of New Zealand Web sites may fail to meet usability requirements.

5.1.8 Importance of education and training in cognitive psychology for developers

A significant minority of the respondents (45%) think that it is not important and necessary for developers to have education and training in cognitive psychology while a minority of the respondents (40%) think that they should. A few of the respondents (15%) indicated that they don't know if it is important and necessary for developers to have education and training in cognitive psychology.

Education and training in cognitive psychology will ensure designers and developers will be able to better understand their target audiences, and hence able to reflect their understanding in their design. Knowledge in cognitive psychology ensures that the Web site that is to be developed will only contain information processing activities which are within the capabilities of the users' mental processing. According to Benyon et al. (1993), cognitive psychology can help to improve the design of computer systems by: (a) providing knowledge about what users can and cannot be expected to do, (b) identifying and explaining the nature and causes of the problems users encounter, and (c) supplying modelling tools to help build more compatible interfaces. The importance of cognitive psychology education for developers is also demonstrated by Norman (2000). Norman says that to provide a quality user experience for the users when they interact with any computer system or Web site or device, the developers have to understand the psychology of everyday things about humans. According to Norman, the principles of visibility, appropriate clues, and feedback of one's action constitute a form of psychology – the psychology of how people interact with things.

The HCI curriculum proposed by ACM in 1996 (Table 4.3.1 and Table 4.3.2) has recommended five courses in cognitive psychology for a computer science major, and two courses in cognitive psychology for information systems major, for undergraduate Information Technology programs. The survey of the six major universities in New Zealand revealed that none of the major universities (Table 4.2.18) have any cognitive psychology courses as a requirement for their undergraduate Information Technology degree programmes. This is a major drawback in education and skills for graduates with Information Technology qualifications in New Zealand who are employed in the industry as Web developers. This should be a major cause for concern for the industry and universities in New Zealand, and there appears to be a need to review the Information Technology curriculum so that appropriate actions are taken to provide an appropriate level of HCI coverage.

5.1.9 If coverage of user interface design subjects in New Zealand is sufficient

Only a few respondents (23%) think that tertiary education providers in New Zealand provide sufficient number of courses and adequate level of coverage for user interface design subjects while a majority (61%) have indicated that they don't know. At the moment it appears that there is not much pressure put on Web developers to develop Web sites with significant attention paid to usability issues. Hence, for now it appears that there is no or very little knowledge in New Zealand for the need to employ people with the necessary knowledge, skills, and qualifications in usability.

The sixty one percent result shows that in New Zealand there is no working relationship between tertiary education providers and the Web development sector. The industry has to play a vital role in determining the HCI curriculum. There needs to be a working relationship between universities and the industry where they are aware of each other's needs. While New Zealand universities host HCI conferences on a regular basis it is important that these conferences also attract participants from industry which will make the people from industry aware of usability issues and what is happening in this area.

5.1.10 What should be taught for HCI courses

The responses indicate that the respondents are pointing the need to include cognitive psychology subjects in Information Technology curricula in New Zealand. The views of these respondents indicate that they require knowledge, education and training to help better understand their target audiences.

5.1.11 Specialization in user interface design

A majority of the respondents (56%) think that tertiary education providers should provide specialization in user interface design or HCI. A few of the respondents (24%) think that there is no need for it while the other respondents (19%) indicated that they don't know. The fifty six percent result is a good reason why the six major universities in New Zealand need to review their Information Technology curriculum to see how they can fit in a major and minor in HCI with their current undergraduate Information Technology programs.

The curriculum proposed by ACM (Table 4.3.1 and 4.3.2) for HCI study is a four year, eight semester program with five courses per semester. In New Zealand, the six major universities' fulltime Information Technology undergraduate degree programmes are for three years with four courses per semester, and implementing the ACM proposed HCI programme may mean students will have to do more courses per semester if the duration of the entire programme is to remain three years of fulltime study. A detailed study may be needed to determine what effect it would have on students' overall academic performance and their ability to cope with studying for more than four courses per semester.

Another major problem that most of the six major universities in New Zealand will have to overcome is to attract academics who could teach in this area of study. Survey of the six major universities (Table 4.2.14) revealed that in total there are only ten academics in the six major universities with appropriate masters and doctoral qualifications, and one with a Bachelors degree, from the twenty five academics who could teach HCI courses. The results from the survey of the six universities also show that some of the HCI courses that are currently offered by universities are taught by academics who have no appropriate postgraduate qualifications in the HCI area.

5.1.12 Usability budget

A significant majority of the respondents (79%) do not have usability as a separate line item for their design and development budget. This result is by no means surprising and is a fair reflection of the low level of awareness in New Zealand of the necessity to use appropriate methodologies, processes and professionals to design user interfaces based on user research, and the involvement of representatives of various user groups in design wherever possible.

Having a separate budget set aside for dealing with usability issues ensures that a fixed amount of time and other resources are spent on learning about user characteristics and reflecting those characteristics in the user interface and functionalities of Web sites and Web-based products. It also ensures that appropriate time is spent on several rounds of evaluation and improvement of the user interface, until results indicate that the target audiences will not have problems in using the Web site or Web-based application.

5.1.13 Reasons why no separate budget is allocated for usability

A significantly majority of the respondents (82%) indicated that resources are only allocated for design and development of the functionalities of the Web site. This result further indicates that there is little awareness in New Zealand of designing and developing Web sites and Web-based applications with usability in mind. It also confirms what is said by Karat and Dayton (1995) that in most cases of the design and development of commercial software, usability is not dealt with at the same level as the other aspects of software engineering.

A few of the respondents (10%) indicated that additional funding is not necessary to fix usability issues. But according to Nielsen (2003b) even a tiny budget will substantially improve a Web site's business value. It appears that many in the business community in New Zealand believe that whatever developers come up with will work quite well for them, since the Web developers are experts in their field. But the majority of developers in New Zealand do not have the required education and training in HCI that would enable them to design Web sites and Web-based applications which will have human elements in them.

A minority of the respondents (43%) indicated that the developers are skilled and experienced enough to take care of usability issues. This result is contrary to what is said by Grudin and Poltrock (1998), that the development of the interface of a product should include designers, developers, human factor engineers and other professionals. According to them the problem is an overall lack of management understanding and support for human factors, which seems to be very relevant in New Zealand's case. This result is another reason to believe that there is a lack of understanding of usability issues not only amongst designers and developers but also amongst the business community who have Web sites.

5.1.14 Percentage of fund allocated to usability budget

A minority of the respondents have their usability budget between 5% and 10% (38%) and between 10% and 15% (38%) of their total budget for design and development while none had more than 15% of their total budget for design and development as usability budget. Only a few of the respondents have 5% or less (8%) of their total design and development budget as their usability budget. A few of the respondents (16%) indicated that they do not know how much is spent on usability.

According to Nielsen (2003b), development projects should spend 10% of their budget on usability. He says that following a usability redesign, Web sites increase usability by 135% on average. Nielsen says that the cost of usability doesn't increase linearly with the project size since many usability activities cost about the same, regardless of how big the project is. It is important to educate the New Zealand Web community about these issues. Before they will want to commit to usability throughout the design and development of Web sites and Web-based applications, the Web site owners need to be informed of how much it will cost and what benefits will result from it.

5.1.15 Sources for usability related articles

A significant minority of the respondents indicated that they and their design teams regularly read PC magazine (48%) while a minority indicated Net Guide (37%). These two local computer magazines have very little or even no articles on usability in their regular publications. A few of the respondents (16%) read Web Graphics and Computer World magazines but these two are not known for publishing articles or research papers on HCI or usability issues. Only a few of the respondents indicated that they and their design teams read The ACM Communication (3%), MIS Quarterly Journal (2%), IEEE (6%), and The Information Systems Research Journal (11%). These four journals have substantial publications, news, and articles on almost all aspects of usability concerning Web sites and Web-based applications. The ACM digital library contains almost every research publication that deals with HCI and usability in Information Technology products. The unpopularity of the ACM Communication, IEEE, Information Systems Research, and the MIS Quarterly Journal may suggest why very little is known about usability issues in New Zealand.

5.1.16. Awareness of articles from well known usability specialists and consultants

A majority of the respondents (55%) indicated that they have read or heard about articles by Jakob Nielsen. While Jakob Nielsen's usability articles are known in New Zealand the results of the survey suggests that usability practices are basically ignored in the design and development of most of the Web sites in New Zealand. Dr. Jakob Nielsen is very well known and regarded for research and publications (www.useit.com), seminars, conferences and tutorials in the U.S., U.K., and Australia on Web usability.

A few of the respondents indicated that they have read or heard articles on usability in New Zealand by Aaron Marcus (8%) and Jarred Spool (11%). Aaron Marcus' research and publications are mostly focused on cultural and elderly user consideration issues for user interface design of Web sites. Jarred Spool is another up-and-coming usability specialist who frequently publishes research work on user interface design with User Interface

Engineering (www.uie.com), and is also highly regarded for road shows, conferences, seminars and tutorials in usability in the U.S. and United Kingdom. A minority of the respondents (40%) did not provide any response to this survey question which suggests that they have not heard of any of the listed leading usability professionals.

5.1.17 Tasks undertaken to meet the needs of users

A majority of the respondents (65%) indicated that they design Web sites based on the existing knowledge of the users. The design should always reflect the users' or the target audiences' characteristics if this data is available, and no design should be based on assumptions on what will work for users regardless of the type and nature of the Web site being developed. Web designers and developers should understand that Web sites provide an opportunity for owners to showcase their product beyond existing clients and customers, and every effort should be made to identify potential customers, learn about them, and to reflect their knowledge of them in the design of their Web sites and Web-based applications.

Less than a third of the respondents (32%) indicated that they do user research to base their design on. This result indicates that majority of the Web sites are being designed and developed based on assumptions regarding the target audiences, without the necessary ground work being done to collect user data. According to Kuniavsky (2003) the user data should include: (a) personal information, i.e. age, gender, income and purchasing power, location, cultural background, education, (b) technological information, i.e. the user's hardware, skills, type of Internet connection, experience in using computers in general, browser brand, operating system, (c) Web use information, i.e. how long they have been using Web, how often they use the Web, (d) information about their environment, i.e. home or work, (e) information on their lifestyle, i.e. values and attitudes, the media they use, what other Web sites they like, (f) knowledge, i.e. are they an expert or a newbie, product knowledge, competitive awareness, and (g) information on their usage trend, i.e. the frequency of their use, and their loyalty to a product.

According to Dykstra-Erickson and Curbow (1997), user studies can help to support good design decisions and provide input for changing unsuccessful design decisions. According to Nielsen (2003c), one of the main benefits of letting user research design drive design is that designers and developers do not have to spend time on features that users do not need, and early user studies will show where to focus their resources so that the developers can ship products on time. According to Merholz (2003), while it is impossible to study every potential user, the first step should be to identify the key audience types, and the next is to observe enough users to ensure that behavioural trends are uncovered. According to Spool (2003b), the most valuable asset of a successful design team is the information they have about their users – when teams have the right information, the job of designing a powerful, intuitive, easy-to-use interface becomes tremendously easier.

User study is also advocated by Israelski (2000), who says that companies that enjoy Web success do a thorough study of their user's needs and behaviours and pay serious attention to the human factors of design. The results in Table 4.1.17 show that twenty one percent use demographic data obtained from market research as a basis for the design of their Web sites. Just relying on demographic data from market research reports as a basis for Web design will not accurately reflect all the necessary characteristics of target audiences which need to be considered in order to develop a usable Web site. According to Kuniavsky (2003), demographic data is just the beginning of what is needed since the market research report only provides demographic descriptions about traditional measurable values such as age, title, and income. More information is needed regarding the target audience if Web sites and Web-based applications are to be designed and developed with a human element in it.

A minority of the respondents (40%) indicated that they use available staff to represent the target users. Collecting information from available staff to determine the user characteristics, and using this information as a basis for the design of the user interface, will not accurately reflect what the target audience will want or expect from the Web site or the Web-based application since not all of the target audience will have similar skills, experience, knowledge, intentions, and views about using technology to the staff of the organization. The forty percent result is significantly high and it is a bad practice, so it is very important that awareness is created amongst the designers and developers to educate them that knowing the real facts about the users increases their creativity and inspires them to focus their energy on real problems.

A majority of respondents (68%) also indicated that they design based on business objectives and functions. Basing design on business objectives and functions causes many usability problems since the focus is not on what will not work for users, or what the users can do and what they will not be able to do, but on what the organization is all about and what it can deliver. According to Nielsen (2000), such sites often reflect so called company-centrism, where the developers present the company as they see themselves, without regarding the visitors and potential customers.

5.1.18 Methods used to collect user data

Individual interviews (35%) and focus groups (35%) are the two mostly used methods by the respondents. A minority of the respondents indicated that they use task analysis (32%) and contextual inquiry (29%). Only a few of the respondents indicated that they use postal surveys (16%) and online surveys (15%). It was expected that all of these techniques would be used by most of the respondents. It was also expected that designers and developers would be familiar with these methods and they would know when and in what situation to use each one of these techniques to collect data about the target audiences. All these techniques should be mantra of all designers and developers of Web sites and Web-based applications in New Zealand. These results suggest that the majority of designers and developers are not familiar with all the listed techniques that play a critical role in learning about the target audiences.

5.1.19 Reasons why contextual inquiry is not used

A significant minority (45%) of the respondents indicated budget constraints as the reason for not using contextual inquiry while a minority (32%) of them indicated that other methods are sufficient. Contextual inquiry is one of most important and valuable techniques used to learn about the target audiences. By watching and observing target audiences carefully, it is possible to understand what problems they face and how the product which is being developed will fit into their lives. It helps the designers to understand the real environment people live in and work in, and reveals their needs within that environment. It can also reveal some unexpected competition and peoples' real values.

A few of the respondents (11%) indicated that difficulty in identifying the potential users prevents them from using contextual inquiry. While it is difficult to identify exactly who the users are, if an appropriate methodology is adopted that involves creating user profiles, appropriate matches for potential users can be identified and studied. A few of the respondents (18%) indicated that the short time frame for Web development prevents them from using contextual inquiry. This is a major challenge to overcome if usable Web sites and Web-based applications are to be designed and developed. The relevant stakeholders have to be educated and informed that if quality and high value Web sites and Web-based applications are to be developed then appropriate methodologies have to be adopted. It involves various phases and processes that guide the design and development process and require a considerable amount of time.

In New Zealand there appears to be an ad-hoc approach to Web development which ignores the use of appropriate methods and techniques to design and develop usable Web sites and Web-Based applications. There is a lack of information, knowledge and understanding about contextual inquiry method and the benefits it will bring by using it to learn about the target audiences. The contextual inquiry gets the design team absorbed in the environment of the target audiences and allows them to discover critical details that there is no other way of discovering. According to Spool (2002a) techniques like contextual inquiry enable the designers to provide quality user experiences with Web sites. Israelski (2000) says that companies that enjoy Web success do a thorough study of their users' needs and behaviours thorough observations of a cross section of the Web sites' intended users. According to Kujala and Mantyla (2000), a contextual type semi-structured interview for user study helps to develop products that are more usable and desirable.

5.1.20 User characteristics on which design is based

A majority of the respondents indicated that they base their design on the knowledge of users (60%) and on users' intentions (55%). A significant minority of the respondents indicated that they base their design on; the skills (45%) of the users, experiences of the users (45%), and on the context in which the users will use the Web site (48%). A few of the respondents (21%) indicated that they do not use any of the listed user characteristics to design Web sites. The results suggest that the majority do not gather and analyse information on all of the five listed important user characteristics which enable to design quality and usable Web sites and Web-based applications. According to Spool (2002b), the user's intentions, context, knowledge, skills, and experiences are essential things that every designer needs to know.

5.1.21. Creating user groups

A majority of the respondents (63%) indicated that they categorize their users into various user groups on which they base their designs. But the results in Table 4.1.17 show that only thirty two percent indicated that they actually do any user study. So the majority of these respondents actually categorise users into various user groups based on assumptions about their likely users. It is the analysis of user data which provides useful knowledge about the users' characteristics.

A few of the respondents (23 %) do not categorize their users into any user groups. By categorizing the users into various user groups, the designers are able to provide a quality user interface according to the types of the users who are expected to use Web sites and Web-based applications. Spool (2003b) says that it is important to identify the expertise of users before you actually start to develop the software and it is useful to categorize users into various user groups on which the design should be based.

5.1.22 Characteristics used to create user groups

A minority of the respondents use user roles (40%) and functions of the Web sites (39%) to categorise users. Using functions of the Web sites to decide on various user groups is a bad user interface design practice in terms of designing a usable interface. Actually it is the various user groups that are identified should reflect the functions of the Web site and accordingly the user interface. It is the user study that leads to the identification of the various user groups. A few of the respondents (10%) indicated that they use shared similarities of users to categorize them into various user groups.

This study has revealed that only thirty two percent of the respondents (Table 4.1.17) do any user study, hence the majority design and develop Web sites and Web-based applications without any real and factual understanding of their target audiences. These results further indicate that the majority of designers and developers in New Zealand are not aware of the benefits of basing their designs on facts and an understanding of users, which are best acquired thorough user study.

5.1.23 Creating user profiles

Only a minority (31%) of respondents create user profiles. In user profiling, users are modelled based on the designer's intuition, judgement, and information on hand about the users. It provides insight into what makes a good user experience and helps to identify the target audiences. Profiles provide a benchmark against which to compare the rest of the user research data collected using techniques such as: surveys, contextual inquiries, and user tests. These results indicate that the majority of the respondents are not aware that user profiles help to understand and identify the potential audience on whom to base their user study.

5.1.24 Characteristics or features used for creating user profile

The respondents who indicated that they create user profiles list the following characteristics of their user profiles: (a) age, (b) education, (c) access rights, (d) user views, (e) user roles, (f) personalization, (h) account number, (i) address, and (j) contact number.

Some of the attributes provided by the respondents such as; (a) age, (b) education, (c) account number, (d) address, and (e) contact number is same as demographic data suggested by Kuniavsky (2003). User role listed by respondents is also suggested Kuniavsky. Kuniavsky listed the following as attributes of user profiles: (a) demographic, (b) technological know how, (c) Web usage, (d) lifestyle, (e) roles, (f) goals, (g) needs, (h) desires, (i) knowledge, (j) usage trends, and (h) tasks. It is important to note that all of these attributes will not be applicable to every project, but they provide a basis on which designers and developers can determine the attributes that may help them to create user profiles. It is always worthwhile for developers and designers to develop a list of attributes that they can refer to when the need arises, and also to keep developing and maintaining it as they acquire knowledge and skills with projects which they undertake. If usability is to be institutionalized in New Zealand, then the designers and developers must be made aware of the benefits of creating user profiles.

5.1.25 User research budget

A significant majority of respondents (86%) indicated that they do not have a user research budget as a separate line item. User research is one of most critical task that needs to be undertaken if usable Web sites and Web-based applications are to be designed and developed. If a good understanding of the target audience is be achieved then appropriate time and resources have to be allocated to it. According to Kuniavsky (2003), the starting point of any user research is a research plan which educates people involved in the design and development process and the management people about the benefits of user research, and also provides a forum for them to ask questions about the target audiences and to gain an expectation of the kind of knowledge the process will produce.

There are very useful techniques such as: (a) user profiling, (b) interviewing, (c) contextual inquiries, (d) focus groups, (e) surveys, (f) task analysis, and (g) usability tests which can be adopted to enable the potential users to be thoroughly studied, data collected, and analysed to gain useful insights into the users. These techniques should be part of any user research that needs to be undertaken, and appropriate time and resources should be allocated to it to ensure that these tasks are undertaken correctly and thoroughly. According to Kuniavsky (2003) the research budget should be based on the following: (a) the time that is required to use the selected techniques to study the target audiences and to collect and analyse the data, (b) recruiting and incentive costs, and (c) equipment costs.

According to Scanlon (1997), successful teams understand that knowledge is power, so they focus on gathering information about their users from as many sources as possible. Successful companies actually do put and keep users first, and relegate technology, implementation, office politics, and everything else to a lower priority. This is only possible when organizations and companies are willing to pay for user study. This survey has revealed that while 32 percent of the respondents do user study (Table 4.1.17) most of them do not allocate any fixed amount of resources to do user study.

5.1.26 Personalization with Web site

A majority of the respondents (59%) indicated that they do not personalize user experiences within their Web sites and Web-based applications. Personalization is one of key features of e-commerce Web sites, and is also being slowly adopted in informational sites. It appears that most of the New Zealand Web sites are informative sites, so personalization features may not be a very common feature.

According to Riecken (2000), personalization is about building customer loyalty by building a meaningful one-to-one relationship by understanding the needs of each individual and helping to satisfy a goal that efficiently and knowledgeably addresses each individual's needs in a given context. Eirinaki and Vazirgiannis (2003) say that personalization can be used to predict user needs in order to improve the usability and user retention of a Web site.

If more businesses in New Zealand are to adopt e-commerce as a tool to increase sales and to enter new markets, then the designers and developers need to have solid knowledge and practical experience in how to design and develop Web sites with personalization capabilities which are clear, usable, memorable, reliable and considerate of all aspects of the visitor's experience. Therefore the biggest challenge facing New Zealand designers and developers of e-commerce sites is the ability to design, implement, and maintain user interfaces and user navigation in a personalized interactive way. Also according Schonberg et al. (2000), it requires defining meaningful metrics and collecting appropriate feedback that serves two important functions: (a) it can be used to nurture loyalty, and (b) it can be used to evaluate the user interface for its effectiveness in meeting users' needs and desires.

5.1.27 Personalized features

Of the respondents who indicated that they provide personalization, an overwhelming majority personalize content (96%) while a majority of them personalize authorization (77%) and links (69%). It is a common practice to personalize content, authorization, and links to enhance usability of the Web sites for the regular users. Based on the nature of the business commonly used features and functions of the Web site are normally personalized for the frequent users and customers. The other features such as email, newsletter, layout, and presentation were also listed as features that were personalized for users.

5.1.28 Reasons that prevent providing personalization

Those respondents who indicated that they do not provide personalization within Web sites, a majority of them (64%) indicated that it is not a business goal at the moment to provide for personalization. The business community in

New Zealand has to be aware that while the Web provides many opportunities it also opens doors to serious competition. Personalization is one way of maintaining a good working relationship with customers and to foster customer loyalty while ensuring the Web site is easy for them to use. New Zealand business Web sites will have to adopt some sort of personalization if they stand any chance of competing with similar businesses from overseas in the global marketplace.

A few of the respondents indicated that knowledge and skills are not sufficient at the moment (19%), and it is not desirable because of the cost involved to design and develop Web sites and Web-based applications with personalized features (25%). While usability is crucial for survival on the Web for business Web sites, for the e-commerce sites, so is the ability to establish and have an on-going relationship with the clients and customers by means of identifying their specific needs and wants – providing for these gives the business an edge over other businesses.

Clients or customers can be very easily lost if their needs and requirements are not properly met to their expectation, since the World Wide Web provides them with options and choices with relative ease. Providing personalized features on the Web is one crucial way, adopted by the majority of e-commerce sites, to establish an ongoing relationship with the users who become the customers or clients.

5.1.29 Iterative design and development

Only 56% of the respondents indicated that it is a standard practice for their design team to use iterative design and development methodology. This methodology can be very effective provided target audiences are involved in various rounds of design and evaluation. It was expected that iterative design methodology would be more widely used since a very strong Information Technology sector in New Zealand which involves a considerable amount of software development. An iterative design and development technique can easily be adopted into any design and development methodology and it is surprising to see it is not one of the work practices of a very large number of

Web developers and development companies in New Zealand. Immediate action needs to be undertaken to inform and educate the designers and developers of how an iterative design and development process is used and what benefits it could bring if it is used for design and development projects.

5.1.30 Reasons why iterative design and development method is not used

Of those who said that they do not use iterative design and development techniques, a few of the respondents(22%) indicated that their design team members are more than capable of making correct design decisions, so iterative techniques are not required. In New Zealand there exist very high skills and talents in coding complex Web sites, and developers have the ability to quickly adopt new technology. This enables developers to develop extremely pleasing and attractive Web sites with graphics, animation and sound which has led people to believe that the product produced will work well for the target audiences. The nature of Web sites is that there is no opportunity at all to train the users, so it is extremely critical that user-centred techniques, processes and methodologies are used to design usable Web sites and Web-based applications.

A few of the respondents indicated that iterative design and development requires considerable time (26%) and it pushes the development cost up (22%). It does require a considerable amount more time since it involves several rounds of testing and refinement until an acceptable design is produced for one particular task before the same process is applied to the next task. It is important that the value of using iterative design and development technique is understood by the design and development team, and also by the client for whom the site is being developed. All the stakeholders should be made aware that in the long run the benefits that will be achieved by having a high value usable Web site or Web-based application will far exceed the cost involved in using an iterative design and development methodology to develop it.

A few of the respondents (15%) indicated that other methodologies are more practical. If usability is not a prime concern then the other methods could be used which are less costly and require less time. But usability is the most important factor and an absolute requirement for survival on the Web – an iterative methodology enables the design and development of a usable product.

A minority of the respondents (30%) did not provide any response which indicates that there is lack of knowledge in New Zealand amongst designers and developers of these methodologies. According to Hudson et al. (1999), iterative design and implementation is now seen as critical to the success of many user interface development efforts. Nielsen (1993) also emphasized that iterative design and development is crucial in order to design and develop high-quality user interfaces for Web sites. Bloomer and Wolfe (1996) of the Hiser Group Australia revealed that they involve users in all phases of the design process in an iterative manner in order to create usable user interfaces. The iterative design process was also used by Fogg et al. (1998), which helped them to identify and understand their intended users, and enabled them to design the interface of a prototype of their product to the liking of their users.

5.1.31 User participation in design and development

A majority of the respondents (55%) indicated that they have no user involvement. User involvement in the design of Web sites and Web-based applications is very important in terms of meeting all the usability requirements. Successful and high quality Web sites which provide value to businesses only result if users are allowed to become active collaborators in the design process rather than passive participants. A study done by Butler and Fitzgerald (1997) on companies and organizations that involve users in project development found that user participation is a major contributor to success in systems development. Hansen et al. (2002) state the importance of users being involved from the beginning, which helps developers to integrate users' expertise and knowledge into their design, and to understand how, when and why people do a task. They say that promising solutions can be tested with these users to verify choices.

5.1.32 How users are involved

Only a minority of the respondents (39%) indicated that users take an active part and are fully involved in making design decisions. Key to designing usable sites is that users should be actively involved in making design decisions by trying out alternative designs to help determine which one will be able to fully meet their needs, and also be able to provide reasons as to why it meets all their requirements.

A majority of the respondents (64%) use the users to test initial design decisions and also for final testing of Web sites before they are launched but only 57% of the respondents use them to test and suggest changes at all phases of development and approve modifications before the next phase is started. The representatives of target audiences should always evaluate and test all the designs that the designers and developers come up with, in order to support what will work for them and also to identify which elements will not suit them so that it is modified. Major benefits result when the users are involved throughout every stage that involves iterative design and development technique, where the focus is on little design and lots of testing until the Web site is completely designed and developed.

Only a few of the respondents (21%) indicated that they reward the users financially for their involvement. To ensure full cooperation and participation, users need to be compensated since the design team will need to spend a considerable amount of time to learn about them. The appropriate target audiences should be identified who are true representatives of the various user groups. It is widely recognised that user involvement is a must if Web site and Web-based application usability is to be improved. In New Zealand, people who are involved in design and development of Web sites have to be informed of benefits that flow when users are part of the design and development process, and why it is necessary to compensate the users who are selected to be part of the design and development work.

5.1.33 Reasons why users are not involved

Those respondents who indicated that users are not involved in design and development, a majority of them (59%) think that user involvement is not necessary. A minority of the respondents indicated that users do not have the necessary knowledge and skills to be part of the design team (26%), and it is not practical to involve users to help make design decisions (32%). A few of the respondents (15%) also indicated that user involvement is seen as a hindrance for Web sites to be developed on time.

These results further show that the there are misconceptions and very little awareness of the importance of user involvement in the design and development of Web sites and Web-based applications. It appears that it is necessary for most people who are involved in the design and development of Web sites in New Zealand to be educated about: (a) why user involvement is necessary, (b) the entire process of how to identify and select the target audience, and (d) how to manage them throughout the process so that the best input can be obtained from them. It is important that Web design and development companies, and large organizations that have their own design and development teams have systematic procedures put in place to recruit appropriate users to be part of the design team, which will make a huge difference in the final product that will be developed.

5.1.34 Methods used to gather design ideas

A majority of the respondents indicated that they use brainstorming (71%) and workshop (64%) technique. While only a few of the respondents use the storyboarding technique (26%). The pencil and paper exercise, the cheapest technique, is used only by a minority (36%) of the respondents. There is no reason why storyboarding and pencil and paper technique could not be part of the design tools of most of the designers and developers. These two techniques are simple, easy to use, and are a very effective way to elicit ideas, views, and other relevant information that will play crucial role in developing a usable product. It was expected that nearly all of the Web designers and developers have knowledge, skills, and training in these techniques and have the ability to identify and use the one or ones that are best suited for a particular situation.

5.1.35 Evaluation stages

A majority of the respondents (65%) indicated that they evaluate the design throughout the design and development process. If this practice is used with usability in mind it will ensure that all of the likely usability issues, problems, and concerns will be identified if target audiences are used in evaluation. The idea of little design and lots of evaluation should be part of user interface design education, training, and work practice, and become a theme for all designers and developers. The major benefit it provides is that all the likely usability errors are identified and fixed as the design progresses, which is much easier and less costly than identifying and fixing errors later.

A few of the respondents (21%) indicated that they evaluate the design at the end of the development before the product is released. Evaluation at the end of development can turn into a very costly exercise if major problems are identified which may require a complete redesign and development of the entire Web site or Web-based application.

A few of the respondents (15%) indicated that they evaluate at the end of each design and development phase, but ideally evaluation should happen more regularly – probably after an item or an element has been designed to see if it will function as planned and produce the desired result.

5.1.36 Evaluation methods used

A minority the respondents indicated that they use think aloud technique (31%) and model based evaluation method (27%). A few of the respondents indicated that they use cognitive walkthrough (18%), heuristic evaluation (19%) and review based evaluation method (19%). These results show that the discount evaluation techniques such as cognitive walkthrough, heuristic evaluation, and think aloud are not popular despite these techniques being advocated as easy to learn and use.

It is worthwhile to note that review based evaluation is mostly used when design and development is to be completed within a short timeframe. According to Yee (2002), review based evaluation is strictly a diagnostic tool, which means that it is not intended to substitute for data gathering, usability testing, or a well-informed redesign process. Savage (1996) compared the results of three different user interface evaluation techniques: (a) expert reviews, (b) user reviews, and (c) interactive usability testing. She found out that user reviews resulted in significantly more redesign of the user interface, but required most effort, and were expensive to conduct.

A few of the respondents (19%) indicated that they do not use any of the mentioned methods for evaluation, which indicates that an ad hoc method of evaluating is used. Designers and developers have to be made aware that using a well established and documented evaluation technique helps to collect reliable and accurate evaluation data on which the necessary changes can be based.

From these results it appears that the majority of designers and developers in New Zealand do not have any skills, knowledge or awareness of discount evaluation techniques – especially cognitive walkthrough and heuristic evaluation. Also there is a general lack of awareness of other useful evaluation techniques such as GOMS, review based evaluation and model based evaluation. It is critical, if usable Web sites and Web-based applications are to be designed and developed, that designers and developers have education, knowledge, training, and skills in various evaluation methods, so that they are able to employ the ones which are applicable to a particular Web development project.

5.1.37 Reasons why discount usability evaluation methods are not used

Of those respondents who indicated that they do not use any of the discount usability evaluation techniques, a majority of them (50%) said that they were not aware of these techniques, while a few of them (24%) said that they do not know how to use any of these techniques. These techniques are easy to learn and use, and also are cheaper, while producing reasonable results most of the time.

A few of the respondents (5%) indicated that these techniques do not provide accurate and reliable usability evaluation data. The nature of the discount usability methods, which are simple and cheap, may always put a question mark over the reliability of data they produce. According to Cockton and Woolrych (2002), there will always be a place for discount methods, but there is a need to improve all HCI methods, so that discounted methods are less discounted and "full strength" methods can be applied in more contexts. Jeffries et al. (1991), Kantner & Rosenbaum (1997), and Nielsen & Molich (1990) state heuristic evaluation as a very effective and useful tool while John and Packer (1995), Lewis et al. (1990), and Blackmon et al. (2002) describe the Cognitive Walkthrough method as a very useful tool for the evaluation of user interface design.

5.1.38 Usability issues for elderly users

A majority of the respondents (61%) indicated that they do not consider usability issues for a special group of users such as elderly users. Research indicates that older users are one of the fastest growing user groups that have adopted the Web for researching health, disease and medicine, news, tracking investment, shopping, and online banking. Usability issues for elderly users have been ignored all over the world, and according to Nielsen (2002d), even though the Internet enriches many seniors' lives, most Web sites violate usability guidelines since these sites are difficult for many seniors to use. He says that current Web sites are twice as hard to use for seniors as compared to non-seniors.

Designers and developers in New Zealand have to be made aware that not every one of the elderly users will have perfect vision, motor control, and know everything about the usage of the Web site – many of them have never used computers and the Internet during their working careers. According to Gregor et al. (2002), elderly people encompass an incredibly diverse group of users, and even small subsets of this group tend to have a greater diversity of functionality than is found in groups of younger people. So this type of knowledge and information should always be part of the education and training of designers and developers so in the future they will be able to design and develop usable Web sites which will meet the needs and requirements of elderly people as well.

5.1.39 Usability features for elderly users

Of those respondents who indicated that they consider usability issues for elderly users, a significant majority of them (71%) use appropriate font sizes. One of the common problems identified by Hanson (2001) was that older people face vision problems, which has a severe effect on elderly people using the Web. One of the ways to counter this problem is to use bigger 12 point font size, which uses a normal straightforward font style. And according to Nielsen (2002d), one way to improve usability for seniors is to support larger font sizes. He says that larger text for links and command buttons are a more prominent target for clicking.

The seventy one percent result shows that not all designers and developers are aware of usability issues for elderly users. It also appears that Web site developers are mostly young people, who base their design on young users. At present it seems that Web sites and Web-based application design is focused on youth, speed, and early adoption of constantly changing technology. According to Worden et al. (1997), even experienced older computer users move a cursor much more slowly and less accurately than their younger counterparts. Their findings show that older adults faced more difficulty than younger users when the targets became smaller.

Only a minority of the respondents indicated that they use static elements (33%) to meet the requirements of elderly users. As people grow older their abilities change, which is a decline over time in the cognitive, physical and sensory functions. According to Marcus (2003b), this can have a negative effect on the performance of a number of tasks, including basic pointing and selection tasks common to today's graphical user interface. So the elements within interfaces that are constantly moving such as animated icons, objects, or images that require clicking for selection, will create enormous difficulties for elderly users.

Only a minority of the respondents indicated that they enable users to change the font size (33%) to meet the requirements of elderly users. Another way to cater for elderly users since they have limited physical capabilities is to provide for features that enable them to easily change the font size to make text bigger and visible. This will increase the chance for them to easily point and click on items to make selections or choices within the interface. Judging from these results much has to done in terms of creating awareness, and providing appropriate education and knowledge about elderly users for the designers and developers in New Zealand if Web sites and Web-based applications are to play an increasingly important role in helping older adults to function well in society.

5.1.40 Data collection methods relating to elderly users

Of those respondents who indicated that they consider usability issues for elderly users, only a minority of them use general literature on aging (42%) and observation (38%) to learn about elderly users. Hawthorn (2002) suggests that general literature on aging can be used to obtain recommendations for successful interface design for elderly people. The attention of designers and developers in New Zealand needs to be drawn to the fact that the general literature on aging could be a good source of information on how aging affects: (a) cognitive areas such as memory, learning, and intelligence, (b) perceptual, and (c) motor abilities. Using this knowledge, together with other appropriate methods to learn about elderly users, the designers and developers will be able to produce Web sites that provide pleasing user experiences for elderly users.

There is no substitute for observing elderly users performing some task to learn what they were able to do without any major problems, how long it took, and what items, elements or tasks caused difficulty. The observation method will produce the richest possible data, which when analysed will provide what will work or not work for elderly users. Hawthorn (1998) points out that relying on survey based data for elderly users may significantly under-report difficulties that older people may encounter when using a system. He suggests that direct observation or discussion groups be used when researching issues concerning elderly people. Nielsen (2003b) also strongly supports the idea that designers and developers must closely observe individual users as they perform tasks with the user interface. Gregor et al. (2002) propose a user sensitive inclusive design methodology, which according to them enables designers to find and recruit representative elderly users and also helps to identify conflicts of interest between elderly user groups.

5.1.41 Cultural consideration

A majority of the respondents (55%) do not consider cultural issues when they design and develop Web sites and Web-based applications. This suggests that the designers and developers may tend to believe that their target market will just be local or mostly English speaking. But at present, New Zealand businesses have an enormous opportunity to tap into the non-English speaking marketplace provided there is an understanding of how these non-English speaking audiences do business. In last 5 to 10 years there have been a large number of migrants coming from Asia to settle in New Zealand hence it provides an opportunity to learn about cultures of these people and use it to develop feature of software that would be well understood if the product is made available there.

To be successful it requires an understanding of the target markets and of the cultures of people whom they want to do business with. For designers and developers they must ensure that the elements or items they decide to have within the interface, audiences will be able to understand and relate to, and will not be offended by them. According to Aykin (1999), designing products for international markets requires an understanding of internationalization and localization concepts. And Marcus (1999) believes that professional designers for specific cultures can design successfully for other cultures given there is significant input from the target cultures and time to do iterative improvements in the designs based on user evaluation.

Russo (1993) highlights the importance of establishing a close working relationship or partnership with natives from the target cultures to identify culturally specific requirements, and the importance of performing usability testing with native users at the same time as the domestic usability tests, i.e. before the product is released. Marcus (2001) says that many analysts have studied cultures thoroughly and published classic theories, and the other authors have applied these theories to analyse the impact of culture on business relations and commerce, but these works are not well known to the user interface design community. This is quite true in New Zealand's case as the results in Table 4.1.41 suggests. There needs to be a considerable amount of effort put in to inform and educate designers and developers on this issue in New Zealand.

5.1.42 Cultural features

Those respondents who indicated that they consider cultural issues, a majority of them (62%) indicated that they use well researched, appropriate, and meaningful metaphors. These ensure that the icons or elements used will be understood by the target audiences and will not confuse or offend any particular culture. Marcus (2001) explained that the sacred colours in the Judeo-Christian West (e.g. red, blue, white, and gold) are different to Buddhist saffron yellow or Islamic green. So it very important for designers and developers to understand that something that may be well liked and appreciated in one culture may be offending to another culture. According to Nielsen (1990), if a Web-based application is also expected to attract an international audience then a careful consideration has to be given to ensure that the words, terms, colours, grouping of items, organisation etc. that are used are relevant and meaningful to the international users.

Only a minority of the respondents (32%) indicated that they provide features that enable users to adjust. One of the factors that determine the acceptability and usability of a localized Web site are the features that enable the target audience to adjust to their own language, format, and style. Sun (2001) says that the localization process is enabled by providing for adjusting features that include translation, punctuation, dates, weights, measurements, address, currency, and also the aesthetic appeal by adjusting elements such as images, colours, logic, functionality, and communication patterns. Russo (1993) also lists the range of issues that needs to be considered by user interface developers for products that draw an international audience, that include: (a) text, (b) numbers, data and time formats, and images, (c) symbols, (d) colours, (e) flow, and (f) functionality. Interestingly, twenty one percent of the respondents did not provide any responses to this question despite indicating that they do consider cultural issues.

5.1.43 Usability lab

An overwhelming majority of the respondents (99%) indicated that they do not have usability lab. This result further show that in New Zealand there is very little usability consideration in the development process and also there is no awareness of human factors consideration in organizations. Not having a usability lab simply means that Web sites and Web based applications are released without proper observation of how they were used by participants, without any interference by designers or developers, who involved in testing the Web site or the Web-based application.

According to Scanlon (1999), a usability lab can be a powerful tool, visible evidence that the company is willing to spend money and effort to make its product usable. Melkus (1985) describes several benefits of having usability labs, which are: (a) the capability of using multiple observers, (b) having a controlled environment, (c) having the provision of a neutral observation point, (d) the preservation of data, (e) the ability to observe the total system, and (f) a newly acquired understanding of the users at work. According to Berkun (1999), without regular sessions in a usability lab during the development, projects are guaranteed to head in directions that do not benefit the users of the product.

According to Madsen (1999), U.S. software development companies have a long history of having usability labs that has enforced and institutionalized usability. According to Waterson, Landay and Mathews (2002) usability testing in labs provides good qualitative feedback. A usability lab does not need to be extensive since its primary goal is to provide a consistent, quiet, and comfortable space to do research, and there is no reason why Web development companies cannot have such a facility to evaluate products for their clients before they are released.

5.1.44 User involvement in testing of Web sites

A majority of the respondents (52%) indicated that they do not use real users to test Web sites before they are launched The idea of using real users to do the final testing is to identify any likely problems that may be faced by users, which may severely affect the number of people using the site or usages of the Web-based application. The real users when involved in final testing will better the chances of identifying likely usability problems, and will also help to identify any tasks or functions that they think are important which may have been missed or were not included on purpose. While it is time consuming and costly to involve real users to test Web sites or Web-based applications, it provides accurate usability test data rather than depending on usability test data collected when somebody else assumed the role of the real user to test or evaluate the product.

According to Molich (2003), if the goal is to sell usability then 3 to 4 users will be sufficient for testing, and if the goal is to find catastrophic problems to drive an iterative development process, then 5 to 6 users should be sufficient, but if the goal is to find all the usability problems in an interface then a large number of users are needed. Nielsen (2000) strongly feels that the best results come from testing with no more than 5 users and running as many small tests as possible. But according to Perfetti and Landesman (2001), it is the constant exposure to one or two real users with regular testing, rather than testing all at once with many users that produces the best usability test results.

According to Nielsen (2003a), many people believe in user testing, but in real design projects not much testing takes place. This survey result further suggests that many New Zealand Web sites have been designed and developed without any human factor considerations. If usability is to institutionalized in New Zealand then the Web development community has to be informed that usable sites can only be produced if users are involved in the entire design process, and it must be an absolute requirement that users are involved in testing before a product is put into operation. The designers and developers require knowledge and training to conduct quick small tests when faced with design decisions, and the ability to run tests within the deadlines required by projects with a limited timeframe.

5.1.45 How users are selected

An overwhelming majority of the respondents (97%), who involve real users for testing, select users from representative user groups but only a few of them (12%) actually provide cash incentives for users who are involved in testing. If true representatives of each user groups are involved then the majority of usability problems can be identified when the various rounds of tests are conducted.

Some sort of reward or financial incentive will ensure full cooperation and one hundred percent effort on the part of users who are involved in this process, since proper testing requires a considerable amount of time and also people will have to spend their personal time away from what they would have done otherwise. Nielsen (2003b) says that to eliminate no-shows for testing, companies should pay fairly generous incentives to test participants.

Only a few of the respondents (6%) indicated that they use recruitment agencies to select users for testing. According to Nielsen (2003b), if companies do not have a streamlined recruiting process in place with a skilled recruiting specialist, it may be worthwhile to involve a recruitment agency. While the involvement of a recruitment agency may be a costly affair, following the best practices for recruiting will reduce the overall usability cost in terms of running fewer numbers of tests, and will produce test data that can be relied upon. It also removes the burden from the design team to identify, interview, and select appropriate users, which is a time consuming exercise. There needs to be an awareness created in New Zealand of these practices which involves selecting and recruiting users so that the user recruitment process is not seen as a time consuming and expensive affair, and user testing becomes a permanent part of the design process.

5.1.46 Use of published design guidelines

A majority of the respondents (68%) indicated that they do not use any published design guidelines, reference books or manuals when designing user interfaces. This is another indication that in New Zealand many Web sites and Web-based applications are designed and developed without any human factor consideration. User interface design guidelines for Web sites are a recommended course of action that is in support of usability. According to Spool (2002b), using proven guidelines the developers can reduce their overburdened workload and which will also make design work much simpler.

According to Henninger et al. (1997), usability guidelines are becoming increasingly popular with organisations that develop software with significant user interface components. According to Rosenweig (1996), design guidelines can help the voice of the customer to be heard and incorporated into the product, and can often shorten development time. Designers and developers in New Zealand need to be made aware that there are many useful user interface design guidelines that have been developed which can be used to design and develop user interfaces.

5.1.47 Published design guidelines used

The results suggest that the majority of designers and developers in New Zealand have to be made aware of various useful sources from where they could find published research papers and user interface design guidelines that could be used as a reference to help design and develop usable user interfaces. There are many useful reports and white papers published on all aspects of Web site design and development by the Nielsen group, that are made available via the Web site www.useit.com, and by Jarred Spool, that are made available via Web site www.uie.com.

There are many useful user interface design guidelines that are available, including by:

(a) The National Cancer Institute (http://usability.gov/guidelines/index.html)
(b) IBM (http://www-3.ibm.com/ibm/easy/eou_ext.nsf/Publish/572
(c) IEEE (http://standards.ieee.org/)
(d) Sun Micro Systems (http://www.sun.com/980713/Webwriting/)
(e) Stanford (http://www.Webcredibility.org/guidelines/
(f) (http://www.w3.org/TR/WAI-WEBCONTENT/full-checklist)
(g) GNOME (http://developer.gnome.org/projects/gup/hig/)
(h) http://hcibib.org/sam/
(i) Macintosh (http://developer.apple.com/techpubs/mac/HIGOS8Guide/thig-2.html)

Other sources that normally have useful research publications on user interface design are: (a) Communication of ACM journal, (b) Usability News Web site www.usabilitynews.com (a British HCI group), (c) IEEE Computer Society's digital library, and (d) the HCI journal. It is also important to point out to designers and developers that they could always develop their own user interface design guidelines based on user research and study. Instead of using untested guidelines, Spool (2002b) says that a small investment in studying how users interact with existing sites can reveal a lot about what works for the site users on their tasks. From these the understanding of the best practices guidelines can be developed which will be far more likely to be of value than generalized guidelines produced from sites that have little or nothing to do with your work.

5.1.48 The use of Metaphors

A majority of the respondents (69%) indicated that they do not use metaphors with their design. Metaphors are widely used to enhance the user interface of application software including Web sites and Web-based applications. Marcus (1994) describes metaphors as: (a) the fundamental concepts, (b) terms, and (c) images, by which and through which information is easily recognized, understood, and remembered. There is no reason why it should not be part of the toolkit of designers and developers and they must optimise the use of metaphors to meet users' needs and preferences.

According to Stubblefield (1998), developers have used desktop and agent metaphors etc. to enhance the usability of the computer interface. The results indicate that education and training in use of metaphors has to be part of user interface design courses so that designers and developers develop an understanding of how metaphors are used as a basis for human communication. Designers and developers need to develop the understanding that a metaphor may have a different meaning for different users based on their cultural background or ethnicity, so significant research and testing needs to be carried out with target audiences before adopting a metaphor to represent a common task or functionality.

5.1.49 How a metaphor is selected

Responses provided show that none of the respondents actually do research and test to find out how relevant each icon is for the target audience. The important thing that needs to be determined is that a metaphor should not bring negative impact. According to Stubblefield (1998) the use of a metaphor should not have a negative impact, which can cause confusion for the user. Designers and developers in New Zealand have to be made aware of all aspects of the usage of metaphors so that a process is adopted to determine and select meaningful and relevant metaphors which will enable them to make Web sites and Web-based applications more usable for the target audiences.

5.1.50 Developing prototypes

A majority of the respondents (61%) actually develop prototypes of their Web sites. Prototyping should always be a part of the design and development process of Web sites and Web-based applications since it provides an opportunity to try out design ideas to see if they will work or not, and what changes are required. The short timeframe of Web development is one major reason why prototypes are not used to try out design ideas before deciding on the final components of the projects. Prototypes enable flaws to be discovered early.

According to Spool (2003d), prototypes are most valuable when teams can iterate quickly, and are critical to developing a quality and usable design since they provide the ability to take a vision, quickly mock it up, and present it for critique and evaluation. According to Baumer et al. (1996), the projects that they investigated clearly showed that prototyping is well suited to develop and communicate a vision of the future system amongst the members of the development team.

They also found out that the end users were not integrated into the prototyping cycles, and they were not an integral part of the design team, but they were consulted once a coherent vision was built. This may also be the case in New Zealand with the majority of design and development teams. The target audience has to play a major role in design ideas and evaluation of the prototype – only then can successful products result from this technique. According to Spinuzzi (2002), it is essential that information designers employ prototyping as a way to involve users in design approaches for participation and feedback.

5.1.51 Reasons for not developing prototypes

Of those respondents who do not develop prototypes, a number of them did not provide any reason (29%) while a few of them said it was: not important (25%), the budget constraints (25%), and the time constraints (24%) that prevents them from developing prototypes. If prototypes are to be used as a tool for designing and developing Web sites and Web-based applications with a strong focus on usability, then there is a need to show the benefits of using prototypes to designers and developers.

5.1.52. Usefulness of prototyping

Only a minority of the respondents (37%) rated prototyping as essential. This suggests that these respondents will always incorporate prototypes in design and development to test out design ideas. Also a minority of the respondents

(40%) rated prototyping as useful. This result indicates that they may not put an emphasis on developing prototypes. A few of the respondents: did not provide any response to this question (10%), rated prototyping as not so useful (3%), and rated it as useless (3%). These results indicate that there is general lack of knowledge and understanding amongst the majority of designers and developers in New Zealand about the usefulness of prototypes in the design and development process.

5.1.53. Types of prototype

A significant minority of the respondents (48%) indicated that they develop paper prototypes. It appears that the majority of designers and developers think that paper-based prototypes will not produce enough test data from a method that is so cheap and easy to use. But according to Nielsen (2003c) paper prototypes are the fastest and cheapest techniques designers can employ in the design process, but almost the majority of designers never use paper prototyping in real design projects. Grady (2000) also says that paper prototypes are a useful and cheap way to identify and fix the likely usability problems.

Sefelin et al. (2003) did a study to investigate the difference between computer-based and paper-based low fidelity prototypes and found out that paper-based low fidelity prototypes lead to almost the same number of errors that were identified by the users when compared to computer-based high fidelity prototypes. According to Virizi et al. (1996), their experiment showed that the same sets of problems were found with both a low-fidelity paper prototype and a high-fidelity prototype. There is a need to create awareness amongst designers and developers of the benefits of low-fidelity paper-based prototypes that enable them to collect usability data early in the design process. It is well known that it is cheaper to fix problems earlier rather than later when the usability errors are identified towards the end of the design process.

5. 2 Discussion of results of the Survey done with six universities

5.2.1 Participant for the Survey

All the six respondents in this survey were either the heads of the schools or the heads of the departments of computer science and/or information systems of the six major universities. These were the best possible people to provide information for the survey since they play a major role in deciding what is offered in the IT curriculum in the University where they are employed.

5.2.2 Courses in Web Development

The survey results indicate that all six major universities in New Zealand offer Web development courses as part of their IT curriculum. This is a reflection of the Internet and World Wide Web being quickly accepted as an important technology, hence the need to produce graduates with IT qualifications who have the knowledge and skills to design Web sites and other Web-based applications. E-commerce courses are also being adopted as part of undergraduate business degree programmes all over the world, and a browse through of the business undergraduate programmes of the six major universities in New Zealand indicates that most New Zealand universities offer at least one paper in e-commerce or allow students to do e-commerce papers as electives.

5.2.3 Number of Web courses offered

The results in Table 4.2.3 show that only one university out of the six major universities in New Zealand offer a significant number of Web development courses that allows students to do a major in this area of Information Technology. The other universities only offer one or two courses in Web development. The six major universities in New Zealand offer Web development courses within the information systems area of study, and also allow computer science students to do Web development courses as a second major or minor in information systems, or as an elective. The duration of full-time undergraduate degree programmes in computer science and information systems offered by the six major universities in New Zealand are 3 years, or 6 semesters. This may be the reason why the majority of the universities only offer one or two Web development courses as part of their Information Technology curriculum, so that the duration of computer science and information systems study is not prolonged. It appears that the wide adoption of the World Wide Web has forced universities in New Zealand to fit in courses relating to Web development within the structure of their current Information Technology programmes.

5.2.4 Courses in user interface design or HCI

All the six major universities in New Zealand offer HCI courses as part of their IT curriculum. Universities from Australia, the US, and from European countries that offer IT qualifications have now included a significant number of HCI courses with a significant level of depth and coverage in this field. It appears that the level of awareness about usability in these countries is significantly higher than in New Zealand. The appropriate coverage in HCI education by tertiary education providers in these countries has enormously contributed to the institutionalization of usability amongst designers, developers and owners of Web sites.

5.2.5 and 5.2.6

These two questions were not applicable since all the six major universities in New Zealand offer courses in HCI.

5.2.7 Usability labs with universities

Only three of the six major universities in New Zealand have usability labs for their research work and for teaching HCI subjects and only the Human Interface Technology Laboratory New Zealand, which is part of the University of Canterbury (Table 4.3.4), is listed as a major HCI lab in New Zealand by the HCI Webliography (www.hcibib.org/education). New Zealand universities have a major role to play if usability is to be institutionalized in New Zealand. It is well documented that the computer technologies that have enabled computer systems to become more user friendly and easy to use for the general public, especially for home and personal use, are the result of research that was done in HCI by universities.

Despite its importance, it seems that the majority of New Zealand universities have failed to develop HCI courses with appropriate facilities which are on a par with the computer science and information systems courses that these universities offer. New Zealand universities are well regarded and known worldwide for producing skilful and knowledgeable Information Technology graduates, and there is no reason why universities in New Zealand cannot invest in having the necessary equipment for HCI labs for continuous research and development in this subject area.

Universities worldwide are now seen as major players in the research and development of usable Information Technology products as major corporate usability research labs are disappearing (Nielsen, 2002). If universities in New Zealand fail to invest in research in usability or HCI issues then usability may never be institutionalized amongst the necessary stakeholders. There is a need for more New Zealand universities to invest an appropriate level of resources to upgrade the facilities they have now for teaching and research work so that they have recognition worldwide and are able to attract academics and researchers in this area of study from abroad. As shown in Table 4.3.4, some universities in the US and United Kingdom have more than one HCI lab for research work which highlights the growing importance of this field.

5.2.8 Future plan for a usability lab

The results in Table 4.2.8 show that the three New Zealand universities that do not have usability or HCI labs have no plans to have such a facility in the near future. While the specific reasons for not planning to have such facilities in the future were not investigated, it seems that these three universities are comfortable with the coverage and content of the HCI courses in their IT curriculum, and possibly have no interest in research in this area of study for the time being.

5.2.9 Number of HCI papers offered

The results in Table 4.2.9 shows that all six major universities in New Zealand offer HCI courses in the final year of study in their undergraduate degree programmes. Only one university offers a course in HCI in the first year while two universities offer HCI courses in the second year. Most universities in New Zealand will need to offer HCI courses at first and second year in order to provide an adequate level of coverage in this area of study. The HCI curriculum produced by the Curriculum group of the ACM (Table 4.3.1) in 1996 recommended 3 as a minimum, 4 as a recommended, and 5 as a maximum number of HCI papers for HCI specialization within computer science, and 2 as a minimum, 3 as a recommended, and 3 as a maximum for HCI specialization within information systems, for undergraduate degree programmes.

With New Zealand universities there are three that offer only one HCI course, and one university that offers two courses, while two other universities offer three papers in HCI in their undergraduate computer science and information systems programmes. The results in Table 4.2.9 indicate that three New Zealand universities will be able to meet the minimum requirements of the ACM's recommendation for the number of courses for HCI specialization within the information systems area of study. From these three, only two will be able to meet the minimum number stated for a computer science major. But these universities will need to include courses from other disciplines which support HCI such as psychology, cognitive science, social science, and other relevant disciplines if they are to offer minor study in HCI.

Most of the six universities in New Zealand will need to increase the number of HCI courses if HCI is to become a major area of study. At present it is not compulsory for students to take up HCI courses as a requirement for Information Technology undergraduate degree programmes at most New Zealand universities. Table 4.3.3 lists all the universities worldwide that offer major or minor study in HCI and it does not include any New Zealand universities as a provider of undergraduate HCI qualifications.

5.2.10 HC specialization

The results in Table 4.2.10 show that none of the New Zealand universities provide HCI specialization. This is the major reason why there are no usability consultants or usability companies in New Zealand and why most of the design and development team does not have any usability professionals. The results of this survey also suggest that the majority of New Zealand universities are actually struggling to keep up with rapid growth in HCI education since the majority of New Zealand universities only offer one or two traditional courses in this area for their undergraduate degree programmes. There is a fair chance that this limited number of courses focus only on the fundamentals of user interface design and HCI, while broader concepts in this area are ignored. The enormous growth and acceptance of the Internet and World Wide Web has created an awareness of the importance of designing and developing usable products, hence there is a need and place for graduates with HCI qualifications in design and development teams.

5.2.11 Future plans for HCI courses offered as a major or minor study

The results in Table 4.2.11 show that none of the New Zealand universities have any future plans to offer major or minor study in the HCI discipline, which is a major concern. While these universities offer courses in HCI which the students can choose to take if they want, it was not investigated whether academics advise or encourage students to do courses in HCI for their undergraduate Information Technology qualifications. It appears that New Zealand universities are comfortable with the number of courses they offer in HCI and may have ignored the need to provide detailed and in depth coverage of HCI at various levels together with courses from other relevant disciplines that will enhance knowledge in this area of study.

If no immediate action is undertaken to improve HCI education then New Zealand will fall far behind in terms of providing usable and useful software products. It appears that New Zealand universities and academics in HCI have failed to create an awareness of usability. It is also important to note that at present, none of these New Zealand universities run any short courses, tutorials, or seminars in usability for Web developers and software developers.

This also suggests that New Zealand universities and academics are not aware that there is a lack of knowledge of good user interface design practices amongst designers and developers of Web sites. It also appears that there is a lack of a working relationship between industry and academics in the HCI field in New Zealand. Universities have to involve the industry in recommending HCI curricula. The industry can make universities aware of their areas of interest and research if they both work together. Industry can also highlight the importance of HCI by funding research, internships, and by collaborating on projects. The biggest impact that industry can have is by employing HCI graduates. Nielsen (2002) says that overseas e-commerce sites are three years behind US Web sites at usability, and this may be a reflection of the thirty four universities providing qualifications in HCI, and also there are thirty eight usability or HCI labs associated with universities in the US.

5.2.12 Reasons why in future HCI will not be offered as a major or minor study

Three universities indicated that there is no need to offer major or minor study in the field of HCI for undergraduate degree programmes. This response does not stack up with what is happening at universities in other developed countries. Table 4.3.3 shows that in the US there are thirty-four universities that now offer specialization in HCI, in the United Kingdom there are seven universities, and in Australia there four universities. The adoption of computer, Internet, and Web technologies is quite significant for both home and business uses in New Zealand, hence the need to design and develop usable products is more critical now, and usability needs to be a major part of the design and development of these products if people are expected to find these products easy and enjoyable to use.

This further suggests that these New Zealand universities may be ignorant of what is happening out in the industry and business sector. The results in Table 4.2.12 show that one of the universities also indicated that there is no indication from the industry that there is a need for graduates with specialization in HCI, but the results of the survey of industry (Table 4.1.3) show that seventy six percent of the respondents said that usability professionals should be part of design teams. While the results of the survey in the industry reveal that there is a general lack of usability awareness and design practices amongst the majority of designers, the academics in New Zealand that teach HCI courses should be well aware of what is being strongly advocated by other academics, researchers, usability consultants, and practitioners overseas, that usability is critical for survival on the Web, and it is usability professionals who would thoroughly take care of usability issues in applications. Universities need to take appropriate actions now, before organizations and business learn the hard way in New Zealand.

Three of the universities also indicated that funding is another reason that has prevented them from offering HCI specialization. Universities can always justify funding by highlighting the importance of providing such education and taking up research in this area of study. If HCI courses in New Zealand universities are to expand into a major or minor area of study then someone in the universities must recognize the importance of the discipline, and must be willing to fight for its future.

5.2.13 Number of HCI academic staff

The results in Table 4.2.13 show that the six major universities in New Zealand have more academic staff members who could teach HCI courses than the number of HCI courses they actually offer. If each of these New Zealand Universities had to offer more courses in HCI than what they are offering now, they would have the necessary number of academic staff members to teach the extra HCI courses.

5.2.14 Number of Academic staff with HCI qualifications

Of the twenty-seven academics who could teach HCI courses, there are only eleven academics with appropriate postgraduate qualifications in HCI, spread between four universities. One New Zealand University which offers HCI course (Respondent 2) does not have any academic with any qualifications in HCI. While one university (Respondent 1) did not provide any response for this question, there are nine academics spread between four universities that have doctoral qualifications in HCI. This bodes well for New Zealand students who have an interest in this area of study and want to pursue higher education.

If HCI courses that are being offered by these universities have to have an impact on Information Technology graduates, then they must be taught by academics with at least doctoral qualifications in HCI or other related disciplines, which is not the case with all the universities at present. If New Zealand universities are to offer reputable HCI degree programmes, and also have reputable HCI or usability labs, then serious consideration should be given to attract academics and researchers with doctoral qualifications in HCI or other related disciplines, such as cognitive psychology. It would ensure that research in this discipline is undertaken, and more HCI courses offered, which would be up-to-date and relevant. There is an urgent need for New Zealand universities to encourage their academic staff members who are teaching HCI courses to upgrade their qualifications to an appropriate level in this area, and also to continuously research and publish papers in this discipline for interest in HCI to grow in New Zealand.

5.2.15 Number of students doing postgraduate projects or thesis in HCI

One of the universities (Respondent 2) does not have any postgraduate students doing research in HCI since the university does not have any academic staff members with postgraduate qualifications in this discipline to guide and supervise students. This result strongly suggests that universities will only attract students for higher education if highly qualified academics are part of the delivery of courses and the supervision of research projects.

Four universities have a significant number of students, between seven to ten students each, studying towards various postgraduate research qualifications in HCI. Interestingly there are ten students spread between four universities who are studying towards doctoral qualifications that would significantly boost the number of people with doctoral qualifications in HCI from nine to nineteen once these students complete their doctoral thesis. These four universities have 9 academics with doctoral qualifications in the HCI discipline. The results indicate that in the future there will be more people with various postgraduate qualifications in HCI in New Zealand.

5.2.16 Academic staff involved in HCI research

The results in Table 4.2.16 show that five universities in New Zealand have staff members who are involved in research and the publication of papers relating to HCI. This shows that New Zealand academics in this field have an interest in doing relevant research for continuous improvement in the usability of Information Technology products, and that they need to be supported with appropriate facilities and resources.

A substantial level of funding for research work in HCI would also attract highly qualified and experienced people from overseas that would ensure HCI became a major component in Information Technology courses in New Zealand. This would not only ensure that universities in New Zealand are up with the rapid changes in HCI education, but also relevant and up to standard HCI courses would be offered compared to HCI courses at well known universities overseas. The results in Table 4.2.16 show that one of the universities (Respondent 2) does not have any academic staff involved in research work in HCI since it does not have any academic staff member with postgraduate qualifications in HCI. While Respondent 1 did not indicate if they had appropriately qualified academics in HCI, but they have academics who are involved in research and publication in the HCI discipline.

5.2.17 HCI conferences

The results in Table 4.2.17 show that five of the six major universities in New Zealand have staff members that attend seminars and conferences relating to usability, HCI or user interface design. However, it appears that there are very few research publications by New Zealand academics that relates to usability issues in Web sites and Web-based applications, only four publications were identified. Also, it appears that these publications hardly involve any industry input. There are hardly any articles about usability issues of Web sites in local news media and computer magazines by New Zealand academics. It appears that no attempt has ever been made by academics before to study industry practices for user interface design for Web sites in New Zealand, hence no knowledge exists at the moment of what processes, methodologies, and techniques are being used by designers and developers.

It appears that the HCI seminars and conferences hosted by universities in New Zealand have very little input from industry in terms of papers presented by practitioners, and hardly have any research papers on Web usability. There is a need for New Zealand academics in this area to research and publish papers relating to usability issues of Web sites and Web-based applications, and draw the attention of designers and developers to it. It is becoming clearer that universities in New Zealand have failed to create an awareness of usability issues amongst the general public, and in particular to the designers, developers and owners of Web sites. Universities in New Zealand need to continuously learn what is happening in local industry and also abroad, so that appropriate changes are brought about to HCI curricula to make them more relevant.

5.2.18 Cognitive psychology papers for IT course

None of the six major New Zealand universities offer cognitive psychology papers as part of their IT curriculum. The HCI curriculum proposed by the ACM (Table 4.3.1) has a significant number of psychology, cognitive science, and social science papers. It is now widely accepted in the HCI field that cognitive psychology is one of the major disciplines which contributes hugely to the understanding of it. Knowledge in cognitive psychology ensures that systems that are to be developed will have information processing activity within the capabilities of the users' mental processing. From this originates the practices of user study, so that user characteristics are well understood and reflected in the design and development of applications. If HCI education is to be improved in New Zealand then universities need to include cognitive psychology and social science papers for Information Technology qualifications.

5.2.19 Importance of cognitive psychology

All the respondents agree that papers in cognitive psychology would make students better understand usability issues, but this is not reflected in their Information Technology curriculum. This result further suggests that New Zealand universities have not been able to keep up with changes in HCI education. As Information Technology products are becoming more common and are used more to carry out normal daily tasks, there is a need to produce more usable products if they are to be adopted by the majority of the public.

The Web sites and Web-based applications are increasingly being accepted as a very useful tool, not only for business, but also for personal use. Hence the need to design and develop usable sites has become more important now. Universities in New Zealand have to reflect this in the Information Technology education that they offer. Universities need to provide comprehensive coverage of HCI education by offering it as a major or minor area of study, rather than offering only a few papers to make up the number of credits for an Information Technology degree. Cognitive psychology and social science disciplines contribute enormously to understanding HCI, so there is a need to have an appropriate number of cognitive psychology and social science courses in HCI curricula.

5.3. Discussions of HCI courses with overseas universities

ACM SIGCHI Curricula for Human-Computer Interaction

This proposed HCI curriculum was produced by the curriculum group of the ACM, that involved the following people: (a) Thomas T. Hewett (Drexel University), Chair, (b) Ronald Baecker (University of Toronto), (c) Stuart Card (Xerox PARC), (d) Tom Carey (University of Guelph), (e) Jean Gasmen (Virginia Commonwealth University), (f) Marilyn Mantei (University of Toronto) (g) Gary Perlman (The Ohio State University), (h) Gary Strong (Drexel University), and (i) William Verplank (Stanford University). They proposed a framework for a programme based in computer science, and also for an information systems course of study. The proposal assumes a four year undergraduate degree consisting of eight semesters in which students take five courses per semester. They believe that providing students with the option of a set of HCI courses is desirable and viable provided that the core of existing programs is maintained. They also reported that there are a number of students who are not well served by the position of HCI courses in existing computer science and information systems programmes.

5.3.1 ACM SIGCHI Curricula for HCI courses within computer science

The HCI curriculum proposed by the ACM group, shown in Table 4.3.1 for a computer science major has a significant number of HCI courses. Within the computer science major in HCI, four terms (semesters) are recommended for HCI courses, with three terms being the minimum number and five terms being the maximum number of terms for HCI courses to be taught. Altogether there are five different HCI courses being proposed by the ACM curriculum group. The HCI courses offered by most of the New Zealand universities are one or two i.e. for maximum of two terms or semesters. This shows that HCI education offered by New Zealand universities at present would not be as thorough and would not have a wide coverage of subject matters in this field.

With the ACM curricula there are also a significant number of psychology and cognitive science courses that students have to take with HCI courses. All the six major New Zealand universities fail to provide any course for students in psychology and cognitive science for students who choose to do HCI courses. ACM curricula recommend that psychology and cognitive science courses be taught for four terms, with three being the minimum and six being the maximum number of terms for these courses to be taught. There are six psychology and cognitive science courses in total.

ACM curricula also recommend that social science courses to be taught with HCI courses, with three being the minimum and five being the maximum number of terms for social science courses. It proposes four different social science courses to be taught to enhance HCI education. All the six major New Zealand universities fail to provide any course in social science for students who choose to do HCI courses.

5.3.2 ACM SIGCHI Curricula for HCI courses within information systems

Within information systems major, ACM curricula recommend that HCI courses to be taught for three terms, with two terms being the minimum number and three terms being the maximum number of terms for HCI courses to be taught. There are three different HCI courses being proposed by the ACM curriculum group for information systems major but most of the six major New Zealand universities offer one or two courses in HCI.

ACM curricula also recommend that psychology and cognitive science courses be taught with HCI courses i.e. one being the minimum and two being the maximum number of terms for psychology and cognitive science courses. There are two psychology and cognitive science courses in total to be taught with HCI courses in information systems major. For social science courses that need to be taught with HCI courses, ACM curricula recommend one term being the minimum and two being the maximum number of terms. It proposes three different social science courses to be taught to enhance HCI education. All the six major New Zealand universities fail to provide any course for students in cognitive psychology and social science for students who choose to do HCI courses.

There are courses from areas such as Natural Science, Behavioural Science, Media and Design courses which is suggested in the ACM curricula for HCI education which are not offered by most of the six major universities for students who take HCI courses. Based on the ACM curricula for HCI education, it is very clear that New Zealand universities do not provide appropriate education in HCI. Cognitive psychology and social science two important disciplines which contribute immensely to the understanding of HCI are not part of their IT curriculum.

While the ACM's proposed HCI curriculum is a four year fulltime study with five papers per semester, the six major New Zealand universities undergraduate degree programmes in computer science and information systems are three years of full-time study with four papers per semester. But this should not prevent these universities from implementing more up to date and relevant HCI curricula similar to the HCI curriculum proposed by the ACM within their three year undergraduate degree programmes.

5.3.3 Universities worldwide that offer major or minor study in human-computer interaction

The results in Table 4.3.3 show that there are only eleven countries worldwide that offer major or minor study in HCI. There are no New Zealand universities listed as a provider of major or minor study in HCI education while Australia has four universities. There are seven universities from the United Kingdom, thirty four universities from the United States, together with several universities from other European countries and from Canada, listed as providers of sufficient courses to enable students to do a major or minor in HCI. It also does not have any Asian countries listed as a provider of HCI education. It is expected that more universities worldwide will start to offer major study in HCI but the survey of the six major universities in New Zealand revealed that there is no such plans in future to offer a major or a minor study in this area.

5.3.4 Human-Computer Interaction Labs associated with Universities Worldwide.

The survey of six major universities in New Zealand revealed that there are three universities with HCI labs. The results in Table 4.3.4 lists twenty countries that have reputable HCI or usability labs associated with universities from those countries. It lists Human Interface Technology Laboratory New Zealand (HITLABNZ), associated with the University of Canterbury, as the only reputable HCI lab in New Zealand. There are thirty five HCI or usability labs associated with various universities in the United States, while the United Kingdom has twenty seven HCI or usability labs associated with various universities. It also shows that Australia has five HCI or usability labs associated with its various universities.

Some of the universities shown in Table 4.3.4 have more than one HCI or usability lab. Japan and Korea are the only countries from Asia with reputable HCI or usability labs associated with universities from those two countries. The results shown in Table 4.3.4, when compared to the results in Table 4.3.3, show that there are more universities worldwide that have reputable HCI or usability labs than the number of universities that offer major or minor study in HCI. So there is more opportunity to do postgraduate research and study in HCI compared to the opportunity to do an undergraduate degree majoring in HCI.

5.3.5 Human-Computer Interaction or usability labs associated with Government departments, with large corporations and business organizations worldwide.

The results in Table 4.3.5 show that eleven countries worldwide have private HCI or usability labs associated with large corporations and business organizations. The US has eleven such labs, while none exist in New Zealand or Australia.

5.3.6 The major Human-Computer Interaction or usability conferences.

The results in Table 4.3.6 show that at present there are seventeen HCI or usability related conferences that are held on a regular basis. There is a local annual New Zealand CHI (Human Factors in Computing Systems) Conference which is hosted by one of the major New Zealand universities. Recently there was CHI international conference held in Rotorua, New Zealand which had 80 participants. The number of these different conferences in HCI shows that there is a growing interest in this area worldwide.

Chapter 6

6.1 Conclusion

The use of Web sites has grown swiftly in New Zealand since the early 1990s. Many Web sites have appeared overnight, which appear to have completely ignored the usability requirements of users. This research was carried out to establish if designers and developers in New Zealand utilize user interface design practices that have been suggested and published by academics and practitioners that would enable them to design and develop usable Web sites and Web-based applications. The research was carried out using the survey method.

The industry research was conducted based on the literature review, which helped to identify user interface design practices such as: user study, creating user profiles, user participation, user-centred design, iterative design, task analysis, the use of evaluation techniques, involving real users in testing, involving usability professionals, setting a separate usability budget, providing personalized user experiences, prototyping, using relevant and meaningful metaphors, considering cultural issues for target audiences, and considering usability issues for elderly users, that ensure useful and usable user interface are designed and developed for Web sites and Web-based applications. A survey of the six major universities in New Zealand was done to establish what is being taught in HCI, and what resources these universities have in relation to the HCI courses that they offer as part of their Information Technology curriculum.

The research revealed that the majority of designers and developers do not utilize good user interface design practices that would enable them to design and develop usable Web sites and Web-based applications, and also that there is a general lack of awareness in the industry of usability issues amongst all stakeholders. The majority of design and development teams of Web development companies and large organizations, including government departments, do not have usability professionals as part of their design teams. Therefore there is very little usability consideration in design and development, and most teams do not have a separate usability budget set to identify and fix the likely usability problems. The results of the research revealed that the majority of design teams do not do a user study, which is necessary ground work to learn about the target audience, and most base their design decisions on assumptions about the target audiences. The results also indicate that there is a general lack of knowledge of useful and appropriate techniques and methods that are used to do user study and evaluation.

The results exposed that the majority of design teams believe that creating prototypes of design ideas are not essential, and also do not employ paper prototyping. The majority of design and development teams do not involve users in the design and development of projects. Cultural issues for target audiences and usability issues concerning older users are also ignored by the majority of designers and developers. Also the use of metaphors is not properly researched by the majority of designers and developers. The overall results suggest that the majority of design and development teams lack knowledge, education, training, and experience in HCI and usability. Nearly all of these findings are counter to what we now know is necessary for successful Web development and creation of usable software applications of all kinds.

The survey of six major universities in New Zealand showed that while these universities offer HCI courses, the majority only offer one or two HCI courses, which are not compulsory for students to study. The majority of universities in developed countries have realised the importance of HCI and have moved away from offering isolated HCI courses and have adopted more and in-depth coverage of HCI, together with the inclusion of other relevant disciplines such as cognitive psychology and social science to make HCI education more relevant and applicable. These universities now offer major and minor study in this discipline. The survey also revealed that some of the universities in New Zealand have academics who teach HCI courses with no formal qualifications in this area. However, there are nine academics in this area with doctoral qualifications, spread between four universities, and this number will grow since between these four universities there are ten students studying towards a doctorate. Also, while three of the major universities have usability labs, only one has a reputation viable HCI lab. The results of the survey show that none of these universities' Information Technology undergraduate degree programmes require students to do courses in cognitive psychology or social science. The results of the survey also show that none of these universities have any future plans to offer a major or minor study in HCI. These results suggest that the majority of New Zealand universities will need to provide more in HCI education to match the rapid growth in HCI education around the world. The lack of the use of good user interface design practices in industry is a reflection of the type of HCI education currently offered by the six major universities in New Zealand, and it appears that there is little or no working relationship between the universities and industry in this area.

6.2 Recommendations:

1. A further study needs to be undertaken that involves running usability tests to compare selected New Zealand and similar US/Australian Web sites to further determine the level of awareness of usability issues in New Zealand.
2. There is an immediate need to create awareness of usability issues in industry.
3. Universities need to run short courses and tutorials for designers and developers on methods, techniques, and processes that will enable them to design and develop useable Web sites and Web-based applications.
4. It would be useful to establish an association formed between industry (designers and developers) and academics who teach HCI courses in New Zealand, so that these stakeholders are aware of each other's issues and needs.
5. Universities should consider offering and make cognitive psychology courses compulsory for students who take HCI courses with the current undergraduate computer science and information systems programmes.

6. Universities should review their HCI courses with significant input from overseas and industry to see what they have to do to make their HCI education more relevant. The establishment of a committee involving all the universities in New Zealand that reviews and makes recommendations on HCI education and curricula would be very helpful. Significant steps should be undertaken to offer HCI as major or minor study within Information Technology undergraduate degree programmes within the next few years.
7. Universities must ensure that appropriately qualified academics are involved in the teaching and delivery of HCI courses. Universities need to attract more academic staff members with doctoral qualifications in HCI.
8. Universities should dedicate space for usability labs to make HCI courses more relevant and more practically orientated, which would ensure that students will not just have theoretical knowledge, but also practical experience in designing usability tests and observing users during tests.
9. Universities should encourage industry to be involved in HCI research, conferences and publications.

References

Aberg, J. & Shahmehri. (2001). An empirical study of human web assistants: implications for user support in Web information systems. *Proceedings of the SIGCHI conference of human factors in computing systems, USA*, 404-411. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Agarwal, R. & Venkatesh, V. (2002). Assessing a firm's web presence: a heuristic evaluation procedure for the measurement of usability. *Information systems research, 13*, 168-186.

Albers, M. J. (1998). Goal-driven task analysis: Improving situation awareness for complex problem solving. *Proceedings of the 16th annual international conference on Computer documentation, Canada*, 234 – 242. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Anderson, C.R., Domingos, R. & Weld, D.S. (2001). Personalizing Web sites for mobile users. *Proceedings of the tenth international conference on World Wide Web, Hong Kong*, 565 – 575. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Anupam, V., Hull, R. & Kumar, B. (2001). Personalizing e-commerce applications with on-line heuristic decision making. *Proceedings of the tenth international conference on World Wide Web, Hong Kong,* 296 – 307. Paper retrieved July 12, 2003, from http://portal.acm.org/

Ardissono, L., Goy, A., Petrone, G. & Segnan, M. (2002). Personalization in business-to-customer interaction. *Communications of the ACM, 45*, 52-53.

Arnowitz, J., Fijma, D. & Verlinden, J. (2000). Communicating a task analysis with task layer maps. *Proceedings of the conference on designing interactive systems: processes, practices, methods, and techniques, United States*, 346 – 353. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Atwood, M.E. (1995). Discount or disservice? Discount usability analysis – evaluation at a bargain price or simply damaged merchandise.

Conference companion on human factors in computing systems, United States, 176 – 177. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Aykin, N. (1999). SIG on one size fits all? Cultural diversity in user interface design. *CHI '99 extended abstracts on human factors in computing systems, Pennsylvania*, 342 - 342 Abstract retrieved March 12, 2003, from http://portal.acm.org/.

Bailey, G. (1993). Iterative methodology and designer training in human-computer interface design. *Proceedings of the SIGCHI conference on human factors in computing systems, Netherlands*, 198 – 205. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Bailey, R. (2002). Usability in practice: formative usability evaluations – evolution and revolution. *CHI '02 extended abstracts on human factors in computing systems, USA*, 885 – 890. Abstract retrieved July 12, 2003, from http://portal.acm.org/.

Bailey, R. (2003). Use of research-based guidelines in development of Websites. *CHI '03 extended abstracts on human factors in computing systems, USA*, 696 – 697. Abstract retrieved July 12, 2003, from http://portal.acm.org/.

Balbo, S., Coutaz, J. & Salber, D. (1993). Towards automatic evaluation of multimodal user interfaces. *Proceedings of the 1st international conference on Intelligent user interfaces, United States*, 201 – 208. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Barrett, R., Maglio, P.P. & Kellem, D.C. (1997). How to personalize the web. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 75 – 82. Paper retrieved September 12, 2003, from http://portal.acm.org/.

Bauersfeld, F.P. & Slater, L.J. (1991). User-oriented colour interface design: direct manipulation of colour in context. *Proceedings of the SIGCHI conference on human factors in computing systems: reaching through* *technology, United States*, 417 – 418. Paper retrieved September 22, 2003, from http://portal.acm.org/.

Baumer, D., Bischofberger, W.R., Lichter, H. & Zullighoven, H. (1996). User interface prototyping – concepts, tools, and experience. *Proceedings of the 18th international conference on software engineering, Germany*, 532 – 541. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Beier, B. & Vaughan, M.W. (2003). The bull's-eye: A framework for web application user interface design guidelines. *Proceedings of the conference on human factors in computing systems, USA*, 489 – 496. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Bellotti, V. (1988). Implications of current design practice for the use of HCI techniques. In Jones, D.M. & Winder, R. (Eds), *People and Computers IV*, Cambridge University Press, Cambridge, U.K. 13-34.

Benyon, D., Davies, G., Keller, L., Preece, J., Rogers, Y & Preece, J. (Eds). (1993). *A guide to usability: Human-computer interaction.* Workingham: Addison-Wesley.

Berkun, S. (1999). The power of the usability lab. Paper retrieved March 12, 2003, from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnhfact/html/hfactor8_6.asp.

Bevan, N. & Curson, I. (1999). Planning and implementing user-centred design. *CHI 98 conference summary on human factors in computing systems, United States*, 111 – 112. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Blackmon, M.H., Polson, P.G, Kitajima, M. & Lewis, C. (2002). Design methods: Cognitive walkthrough for the web. *Proceedings of the SIGCHI conference on human factors in computing systems: changing our world, changing ourselves, USA*, 463 - 470. Paper retrieved June 29, 2003, from http://portal.acm.org/.

Bloomer, S.A. & Wolfe, S.J. (1996). The Hiser Group: pioneering usability and user interface design in Australia. *Conference companion on human* *factors in computing systems: common ground*, Canada, 141 – 142. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Bochicchio, M. & Paiano, R. (2000). Prototyping web applications. *Proceedings of the 2000 ACM symposium on applied computing, Italy*, 978 - 983. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Bomsdorf, B. & Szwillus, G. (1999). Tool support for task-based user interface design. *CHI '99 extended abstracts on human factors in computing systems, Pennsylvania*, 169 – 170. Abstract retrieved July 22, 2003, from http://portal.acm.org/.

Borges, J. A., Morales, I. & Rodriguez, N.J. (1996). Guidelines for designing usable www pages. *Conference companion on human factors in computing systems: common ground, Canada*, 277 – 278. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Boucher, J. & Smith, M. (2000). Web site redesign follies. *Proceedings of the 28th annual ACM SIGUCCS conference on User services: building the future, United States*, 14 – 18. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Buchenau, M. & Suri, J.F. (2000). Experience prototyping. *Proceedings of the conference on designing interactive systems: processes, practices, methods, and techniques, United States*, 424 - 433. Paper retrieved September 12, 2003, from http://portal.acm.org/.

Burton, C., & Johnston, L. (1998). Will World Wide Web user interface be usable. *Proceedings of computer human interaction conference, Australia*, 39 -44. Paper retrieved July 12, 2003, from http://ieeexplore.ieee.org/

Butler, T. & Fitzgerald, B. (1997). A case study of user participation in the information systems development process. *Proceedings of the eighteenth international conference on information systems, United States,* 411 – 426. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Chaparro, B. (2003). Use of research-based guidelines in development of Websites. *CHI '03 extended abstracts on human factors in computing* *systems, USA,* 696 – 697. Abstract retrieved August 19, 2003, from http://portal.acm.org/.

Chariton, C. & Chio, M.H. (2002). User interface guidelines for enhancing usability of airline travel agency e-commerce Web sites. *CHI '02 extended abstracts on Human factors in computing systems, USA*, 676 – 677. Abstract retrieved August 19, 2003, from http://portal.acm.org/.

Chi, E.H., Rosien, A., Supattanasiri, G., Williams, A., Royer, C., Chow, C., Robles, E., Dalal, B., Chen, J., & Cousins, S. (2003). The bloodhound project: automating discovery of Web usability issues using the infoScent simulator. *Proceedings of the conference on human factors in computing systems, USA*, 505 – 512. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Chin, G. J., Rosson, M.B. & Carroll, J.M. (1997). Participatory analysis: shared development of requirements from scenarios. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 162 – 169. Paper retrieved March 13, 2003, from http://www.acm.org/.

Cockton, G. & Woolrych, A. (2002). Sale must end: should discount methods be cleared off HCI's shelves. *interactions, September + October*, 13-18.

Constantine, L.L. & Lockwood, L.A.D. (1999). Use cases in task modeling & user interface design. *CHI '99 extended abstracts on human factors in computing systems, Pennsylvania*, 352 – 352. Abstract retrieved March 12, 2003, from http://portal.acm.org/.

Constantine, L.L. (1995). Essential modeling use cases for user interface. *interactions, April*, 36 – 46.

Cowan, W.B. (1989). Color in user interface design: functionality and aesthetics. *Proceedings of the SIGCHI conference on human factors in computing systems: wings for the mind*, 25 - 27. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Crow, D. & Smith, B. (1992). The role of built-in knowledge in adaptive interface systems. *Proceedings of the 1st international conference on*

Intelligent user interfaces, United States, 97 – 104. Paper retrieved July 15, 2003, from http://portal.acm.org/.

Demeyer, S., Meijler, T.D., Nierstrasz, O. & Steyaert, P. (1997). Design guidelines for tailorable frameworks. *Communication of the ACM, 40*, 60-64.

Dix, A.J., Finlay, E. J. Abowd, G.D. & Beale, R. (2002). *Human-Computer Interaction* (2nd ed.). Prentice Hall.

Duncker, E. (2002). Cross-cultural usability of the library metaphor. *Proceedings of the second ACM/IEEE-CS joint conference on digital libraries, USA,* 223 - 230. Paper retrieved August 20, 2003, from http://portal.acm.org/.

Eason, K.D. (1998). *Information technology and organisational Change.* London: Taylor & Francis.

Eirinaki, M. & Vazirgiannis, M. (2003). Web mining for web personalization. *ACM Transactions on internet technology, 3*, 1-27.

Evers, V. (2002). Cross-cultural applicability of user evaluation methods: a case study amongst Japanese, North America, English and Dutch users. *CHI '02 extended abstracts on human factors in computing systems, USA,* 740 – 741. Abstract retrieved August 12, 2003, from http://portal.acm.org/.

Farrell, T. (2001). Pros and cons of personalisation. Paper retrieved March 19, 2003, from http://infocentre.frontend.com/servlet/Infocentre/Infocentre?page=article&id=83.

Fink, J., Koenemann, J., Noller, S. & Schwab, I. (2002). Putting personalization into practice. *Communication of the ACM, 45*, 41-42.

Fogg, B.J., Cutler, L. D., Arnold, P. & Eisbach, C. (1998). HandJive: A device for interpersonal haptic entertainment. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 57 – 64. Paper retrieved September 20, 2003, from http://portal.acm.org/.

Goddard, H. P. (2002). HFI certification-fulfilling the needs of the practitioner. Paper retrieved October 12, 2003, from http://www.humanfactors.com/training/Webcasts.asp#certification.

Gong, R. & Kieras, D. (1994). A validation of the GOMS model methodology in development of a specialized, commercial software application. *Proceedings of the SIGCHI conference on human factors in computing systems: celebrating interdependence, United States,* 351 – 357. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Grady, H. M. (2000). Web site design: a case study in usability testing using paper prototypes. *Proceedings of Joint IEEE International and 18th annual conference on computer documentation,* 39 -45. Paper retrieved October 15, 2003, from http://ieeexplore.ieee.org/

Gregor, P., Newell, F.A. & Zajicek, M. (2002). Designing for dynamic diversity – interface for older people. *Proceedings of the fifth international ACM conference on assistive technologies, Scotland,* 151 – 156. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Grudin, J. & Poltrock, S. E. (1989). User interface design in large corporations: coordination and communication across disciplines. *Proceedings of the SIGCHI conference on human factors in computing systems,* 197 - 203. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Gunaratne, A.K. (1999). Human-computer interactions: implications for research and practice. *New Zealand journal of applied computing and Information technology, 3,* 35-41.

Hakim, J. & Spitzer, T. (2000). Effective prototyping for usability. *Proceedings of IEEE professional communication society international professional communication conference, Cambridge,* 47 – 54. Paper retrieved October 12, 2003, from http://ieeexplore.ieee.org/.

Hansen, P., Petrelli. D, Karlgren, J., Beaulie, M., & Sanderson, M. (2002). User-centred interface design for cross-language information retrieval. *Proceedings of the 25th annual international ACM SIGIR conference on research and development in information retrieval, Finland,* 383 – 384. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Hansen. L. A. (1997) Reflections on i/design: user interface design at a startup. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 487 - 493. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Hanson, L.V. (2001). Institutional and Web activities: Web access for elderly citizens. *Proceedings of the 2001 EC/NSF workshop on universal accessibility of ubiquitous computing: providing for the elderly, Portugal*, 14 – 18. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Harrison, B.L., Fishkin, K.P., Gujar, A., Mochon, C. & Want, R. (1998). Squeeze me, hold me, tilt me! an exploration of manipulative user interface. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 17 – 24. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Harrison, S. & Mancey, P. (1998). Optimal amount of time for obtaining accurate usability-test results. *Proceedings of the 16th annual international conference on computer documentation, Canada*, 173 – 179. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Hawthorn, D. (1998). Cognitive aging and human computer interface design. *Proceedings of the 1998 Australasian computer human interaction conference*, 270 – 280. Paper retrieved March 12, 2003, from http://ieeexplore.ieee.org/.

Hawthorn, D. (2002). Towards interface design for older users. *New Zealand journal of applied computing and Information technology, 6*, 26-35.

Heller, R., Jorge, J. & Guedi, R. (2001). EC/NSF workshop on universal accessibility of ubiquitous computing: providing for the elderly. *Proceedings of the 2001 EC/NSF workshop on universal accessibility of ubiquitous computing: providing for the elderly, Portugal*, 1 – 10. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Henninger, S., Lu, C. & Faith, C. (1997). Using organizational learning techniques to develop context-specific usability guidelines. *Proceedings of the conference on designing interactive systems: processes, practices, methods, and techniques, Netherlands*, 129 – 136. Paper retrieved August 11, 2003, from http://portal.acm.org/.

Herman, L. (1996). Towards effective usability evaluation in Asia: cross-cultural differences. *Proceedings of sixth Australasian conference on computer human interaction,* 24-27. Paper retrieved August 10, 2003, from http://ieeexplore.ieee.org/.

Hertzum, M., Jacobsen, N.E. & Molich, R. (2002). Usability inspections by groups of specialists: perceived agreement in spite of disparate observations. *CHI '02 extended abstracts on human factors in computing systems, USA,* 662 – 663. Paper retrieved August 10, 2003, from http://portal.acm.org/.

Holt, O. P. (1991). HCI tools, methods and information sources. *IEE colloquium on usability now,* 5/1 -5/2. Paper retrieved September 10, 2003, from http://ieeexplore.ieee.org/.

Howard, S. (1995). User interface design and HCI: Identifying the training needs of practitioners. *SIGCHI bulletin 27*, 17- 22.

Hudson, E. S., John, E.B., Knudsen, K. & Byrne, D.M. (1999). A tool for creating predictive models from user interface demonstrations. *Proceedings of the 12th annual ACM symposium on user interface software and technology, United States,* 93 – 102. Paper retrieved August 18, 2003, from http://portal.acm.org/.

Hynes, C. (2002). Keeping users stuck to your site. Paper retrieved March 12, 2003, from http://www.humanfactors.com/training/Webcasts.asp.

Hysell, D. (1998). Meeting the needs (and preferences) of a diverse World Wide Web audience. *Proceedings of the 16th annual international conference on Computer documentation, Canada*, 164 – 172. Paper retrieved September 20, 2003, http://portal.acm.org/.

Israelski, E. (2000). Five steps to unlocking a Web site's potential. *IEEEE IT PRO, July/August*, 55- 56.

Ivory, M.Y., Sinha, R.R. & Hearst, M.A. (2001). Empirically validated Web page design metrics. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 53 – 60. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Ivory, Y.M. & Hearst, A. M. (2001). The state of the art in automating usability evaluation of user interface. *ACM Computing Survey, 33*, 470-516.

Jacobsen, N.E., Hertzum, M., & John, B.E. (1998). The evaluator effect in usability tests. *CHI 98 conference summary on human factors in computing systems, United States*, 255 – 256. Paper retrieved October 11, 2003, from http://portal.acm.org/.

Jeffries, R., Miller, J. R., Wharton, C. & Uyeda, K.M. (1991). User interface evaluation in the real world: a comparison of four techniques. *Proceedings of the SIGCHI conference on human factors in computing systems: reaching through technology, United States*, 119 – 124. Paper retrieved July 12, 2003, from http://portal.acm.org/.

John, B. E. & Kieras, D.E. (1996a). Using GOMS for User Interface Design and Evaluation: Which Technique. *ACM transactions on computer-human interaction,3*, 287-319.

John, B.E. & Kieras, D.E. (1996b). The GOMS Family of User Interface Analysis Techniques: comparison and contrast. *ACM transactions on computer-human interaction, 3,* 320-351.

John, B.E. & Packer, H. (1995). Learning and using the cognitive walkthrough method: a case study approach. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 429 – 436. Paper retrieved July 12, 2003, from http://www.acm.org/.

John, B.E. (1995). Why GOMS? *interactions, October*, 81-89.

Johnson, J. & Henderson, A. (2002). Conceptual models: begin by designing what to design. *interaction, January/February*, 25-32.

Johnson, P. (1992). *Human-computer interaction*. Berkshire: McGraw-Hill.

Jokela, T. (2002). Making user-centred design common sense: striving for an unambiguous and communicative process model. *Proceedings of the second Nordic conference on human-computer interaction, Denmark*, 19 - 26. Paper retrieved June 12, 2003, from http://portal.acm.org/.

Kantner, L. & Rosenbaum, S. (1997). Usability studies of WWW sites: heuristic evaluation vs. laboratory testing. *Proceedings of the 15th annual international conference on computer documentation, United*

States, 153 – 160. Paper retrieved August 20, 2003, from http://portal.acm.org/.

Karat, C.M., Campbell, R. & Fiegel, T. (1992). Comparison of empirical testing and walkthrough methods in user interface evaluation. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 397 – 404. Paper retrieved September 11, 2003, from http://portal.acm.org/.

Karat, J. & Dayton, J. (1995). Practical education for improving software usability. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 162 - 169. Paper retrieved August 12, 2003, from http://www.acm.org/.

Karkkainen, L. & Laarni, J. (2002). Designing for small screens. *Proceedings of the second Nordic conference on human-computer interaction, Denmark,* 227 - 230. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Karvonen, K. (2000). The beauty of simplicity. *Proceedings on the 2000 conference on universal usability, United States*, 85 – 90. Paper retrieved August 15, 2003, from http://portal.acm.org/.

Keevil, B. (1998). Measuring the usability index of your Web site. *Proceedings of the 16th annual international conference on computer documentation, Canada*, 271 – 277. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Khalifa, M. (1998). Computer-assisted Evaluation of Interface Designs. *The DATA BASE for advances in information systems, 29*, 66-81.

Kieras, E.D., Wood, D.S., Abotel, K. & Hornof, A. (1995). GLEAN: A computer-based tool for rapid GOMS model usability evaluation of user interface designs. *Proceedings of the 8th annual ACM symposium on user interface and software technology table, United States*, 91 – 100. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Klemmer, R.S., Newman, W.M., Farrell, R., Bilezikjian, M. & Landay. A. J. (2001). The designers' outpost: a tangible interface for collaborative Web site design. *Proceedings of the 14th annual ACM symposium on* *user interface software and technology, Florida,* 1 – 10. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Kramer, J., Noronha, S. & Vergo, J. (2000). A user-centred design approach to personalization. *Communications of the ACM, 43*, 44 - 48

Kubilus, N.J. (2000). Designing an e-commerce site for users. *Crossroads, 7,* 23 - 26

Kuniavsky, M. (2003). *Observing the user experience: a practitioner's guide to user research.* San Francisco: Morgan Kaufmann Publishers.

Kurosu, M. & Kashimura, K. (1995). Apparent usability vs. Inherent usability. *Conference companion on human factors in computing, United States,* 292 – 293. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Laskowski, S.J., Landay, J.A. & Lister, M. (2002). Automatic capture, representation, and analysis of user behaviour. *CHI '02 extended abstracts on human factors in computing systems, USA,* 922 – 923. A*bstract* retrieved July 12, 2003, from http://portal.acm.org/.

Leventhal, L. & Zajicek, M. (2002). "When I'm sixty-four...": are there real strategies for providing universal accessibility for the elderly. *CHI '02 extended abstracts on human factors in computing systems, USA,* 694 – 695. Abstract retrieved March 12, 2003, from http://portal.acm.org/.

Lewis, C., Polson, P., Wharton, C. & Rieman, J. (1990). Testing a walkthrough methodology for theory-based design of walk-up-and-use interface. *Proceedings of the SIGCHI conference on human factors in computing systems: empowering people, United States*, 235 - 242. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Lim, Y. Y. & Usma, M.S. (1998). Usability evaluation in the field: lessons from a case-study involving public information kiosks. *Proceedings of the 3rd Asia Pacific computer human interaction conference*, 70 -75. Paper retrieved August 12, 2003, from http://ieeexplore.ieee.org/.

Madsen, K.H. (1999). The diversity of usability practices: introduction. *Communications of the ACM, 42*, 60-62.

Manber, U., Patel, A. & Robison, J. (2000). Experience with personalization on Yahoo. *Communication of the ACM, 43*, 35-39.

Mantei, M. M. & Teorey, T.J. (1988). Cost/benefit analysis for incorporating human factors in the software lifecycle. *Communications of the ACM, 31*, 428-439.

Marcus, A. (1989). Color in user interface design: functionality and aesthetics. *Proceedings of the SIGCHI conference on human factors in computing systems: wings for the mind*, 25 – 27. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Marcus, A. (1994). Managing metaphors for advanced user interfaces. Paper presented at the workshop on advance visual interface. *Proceedings of the workshop on advanced visual interfaces, Italy*, 12 – 18. Paper retrieved August 16, 2003, from http://portal.acm.org/.

Marcus, A. (1999). SIG on one size fits all? Cultural diversity in user interface design. *CHI '99 extended abstracts on human factors in computing systems, Pennsylvania,* 342 – 342. Abstract retrieved from http://portal.acm.org/.

Marcus, A. (2001). Cross-cultural user-interface design for work, home, play, and on the way. *Proceedings of the 19th annual international conference on Computer, USA*, 221 - 222. Paper retrieved August 20, 2003, from http://portal.acm.org/.

Marcus, A, (2003a). User-interface design and China: A great leap forward. *interactions January/February*, 21-25.

Marcus, A. (2003b). Universal, ubiquitous, user-interface design for the disabled and elder. *interactions March/April*, 23-27.

Marcus, A, & Gould, E. W. (2000). Crosscurrents cultural dimensions and global Web user-interface design. *interactions, July/August*, 33-46.

Marti, P. (1996). HCI in Italy: Task-centred design – Turning task modelling into design. *SIGCHI bulletin, 28*, 1-12.

McKinney, V., Yoon, K., & Zahedi, M. F. (2002). The Measurement of Web-Customer Satisfaction: An Expectation and Disconfirmation Approach. *Information systems research, 13*, 296-315.

Meier, B.J. (1988). ACE: A colour expert system for user interface design. *Proceedings of the 1st annual ACM SIGGRAPH symposium on user interface software, Canada,* 117 – 128. Paper retrieved August 20, 2003, from http://portal.acm.org/.

Melkus, L.A. (1985). The benefits of laboratory testing for usability. *Proceedings of the twenty-first annual conference on computer, United States,* 91 – 96. Paper retrieved September 30, 2003, from http://portal.acm.org/.

Merholz, P. (2003). Casting your user research. Paper retrieved March 12, 2003, from http://www.uiconf.com/8/articles/merholz_article.html.

Molich, R. (2003). Usability Testing Best Practices. Paper retrieved March 12, 2003, http://www.uie.com/articles/molich_interview/.

Muller, M.J., Matheson, L., Page, C. & Gallup, R. (1998). Participatory Heuristic Evaluation. *interaction, september + october,* 13-17.

Munoz, R. (1992). In search of the ideal prototype. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 577 – 579. Paper retrieved August 15, 2003, from http://portal.acm.org/.

Myers, B., Hudson, E.S. & Pausch, R. (2000). Past, present, and future of user interface software tools. *ACM transactions on computer-human interaction, 7,* 3-28.

Myers, B. A. (1998). A brief history of human-computer interaction technology. *interactions, march + april,* 44-54.

Myers, B.A. (1994). Challenges of HCI design and implementation. *interactions, January,* 73-83.

Myers, B.A., Wolf, R., Potosnak, K. & Graham, C. (1993). Heuristics in real user interface. *Proceedings of the SIGCHI conference on human factors in computing systems, Netherlands,* 304 - 307. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Mynatt, E. (2002). "When I'm sixty-four…": are there real strategies for providing universal accessibility for the elderly. *CHI '02 extended* *abstracts on human factors in computing systems, USA*, 694 – 695. Abstract retrieved July 12, 2003, from http://portal.acm.org/.

Newman, W.M. & Landay, A. J. (2000). Sitemaps, storyboards, and specifications: a sketch of Web site design practice. *Proceedings of the conference on designing interactive systems: processes, practices, methods, and techniques table of contents, United States*, 263 – 274. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Nielsen, J. (1990). Designing for international use. *Proceedings of the SIGCHI conference on human factors in computing systems: empowering people, United States,* 291 – 294. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Nielsen, J. (1993). *Usability Engineering*. Boston: Academic Press.

Nielsen, J. (1994). *Usability Inspections Methods*. New York: John Wiley & Sons.

Nielsen, J. (1995). Technology transfer of heuristic evaluation and usability inspection. Paper retrieved July 12, 2003, from http://www.useit.com/papers/heuristic/learning_inspection.html.

Nielsen, J. (1997). Discount usability for web. Paper retrieved July 12, 2003, from http://www.useit.com/papers/web_discount_usability.html.

Nielsen, J. (1998). Personalization is over-rated. Paper retrieved July 12, 2003, from http://www.useit.com/alertbox/20020624.html.

Nielsen, J. (1999). Why people shop on web. Paper retrieved July 12, 2003, from http://www.useit.com/alertbox/20020624.html.

Nielsen, J. (2000). The future of Web interfaces, towards a user-friendly Web. One-day seminar, April 7 2000, Amsterdam, The Netherlands.

Nielsen, J. (2001). Usability metrics. Paper retrieved July 12, 2003, from http://www.useit.com/alertbox/20020624.html.

Nielsen, J. (2002a). Becoming a usability professional. Paper retrieved July 12, 2003, from http://www.useit.com/alertbox/20020722.html.

Nielsen, J. (2002b). Improving usability guideline compliance. Paper retrieved July 14, 2003, from http://www.useit.com/alertbox/20020624.html.

Nielsen, J. (2002c). Top research laboratories in human-computer interaction. Paper retrieved July 12, 2003, from http://www.useit.com/alertbox/20020331.html.

Nielsen, J. (2002d). Usability for senior citizens. Paper retrieved July 23, 2003, from http://www.useit.com/alertbox/20020428.html.

Nielsen, J. (2002e). User empowerment and the fun factor. Paper retrieved July 22, 2003, from http://www.useit.com/alertbox/20020707.html.

Nielsen, J. (2003a). Convincing clients to pay for usability. Paper retrieved July 16, 2003, from http://www.useit.com/alertbox/20030519.html.

Nielsen, J. (2003b). Misconceptions about usability. Paper retrieved July 16, 2003, from http://www.useit.com/alertbox/20030908.html.

Nielsen, J. (2003c). Paper prototyping: getting user data before you code. Paper retrieved August 12, 2003, from http://www.useit.com/alertbox/20030414.html.

Nielsen, J. & Molich, R. (1990). Heuristic evaluation of user interfaces. *Proceedings of the SIGCHI conference on human factors in computing systems: empowering people table of contents, United States*, 249 – 256. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Norman, A.D. (2000). The psychopathology of everyday things. *Readings in human computer interaction, Second Edition*, 5- 21.

Noyes, M.J. & Harriman, J.C. (1995). User involvement in the design process: a case for end-user evaluation of software packages. *IEE colloquium on human centred automation*, 2/1 -2/3. Paper retrieved August 12, 2003, from http://.ieee.org/.

Ogawa, K. & Ueno. K. (1995). Tools for working with guidelines. *SIGCHI bulletin, 27*, 38-39.

Ogozalek, Z..V. (1994). A comparison of the use of text and multimedia interface to provide information to elderly. *Proceedings of the SIGCHI conference on human factors in computing systems: celebrating interdependence, United States*, 65 – 71. Paper retrieved September 22, 2003, from http://portal.acm.org/.

Orubeondo, A. & Mitchell, L. (2000). What makes a useful user interface. Paper retrieved March 15, 2003, from www.itworld.com .

Padmanabhan, B., Zheng, Z. & Kimbrough, S.O. (2001). Personalization from incomplete data: what you do not know can hurt. *Proceedings of the seventh ACM SIGKDD international conference on Knowledge discovery and data mining, United States*, 154 – 163. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Palmer, J. W. (2002). Web Site Usability, Design, and Performance Metrics. *Information systems research, 13*, 151-167.

Perfetti, C. (2003). Usability testing best practices: an interview with Rolf Molich. Paper retrieved October 14, 2003, from http://www.uiconf.com/8/articles/molich_interview.html.

Quintana, C., Krajcik, J. & Soloway. E. (2002). A case study to distill structural scaffolding guidelines for scaffolded software environment. *Proceedings of the SIGCHI conference on human factors in computing systems: Changing our world, changing ourselves, USA*, 81 – 88. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Raskin, J. (2000). *The humane interface.* Massachusetts: Addison-Wesley Longman.

Riecken, D. (2000). Personalized views of personalization. *Communications of ACM, 43*, 27-29.

Rieman, J., Davies, S., Hair, D.C., Esemplare, M., Polson, P. & Lewis, C. (1991). An automated cognitive walkthrough. *Proceedings of the SIGCHI conference on human factors in computing systems: reaching through technology, United States*, 427 – 428. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Ritter, F.E., Baxter, G.D, Jones. G, & Young, R.M. (2000). Supporting model as users. *ACM transactions on computer-human interaction, 7*, 141-173.

Rogers, Y., Sharp, H., Benyon, D., Holland, S., Care, T., & Plumtree, S.C. (Eds). (1994). *Human-computer interaction.* Workingham: Addison-Wesley.

Rosenzweig, E. (1996). Design guidelines for software products: a common look and feel or a fantasy. *interactions, September + October*, 21-26.

Rossi, G., Schwabe, D. & Guimaraes, R. (2001). Designing personalized web applications. *Proceedings of the tenth international conference on World Wide Web, Hong Kong*, 275 – 284. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Rowley, D. E. & Rhoades, D. G. (1992). The cognitive jogthrough: a fast-paced user interface evaluation procedure. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 389 – 395. . Paper retrieved Septemeber 12, 2003, from http://portal.acm.org/.

Rowley, D.E. (1994). Usability testing in the field: bring the laboratory to the user. *Proceedings of the SIGCHI conference on human factors in computing systems: celebrating interdependence, United States*, 252 - 257. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Rubinstein, D. (2003). A successful approach to implementing a corporate Web design standard. Paper retrieved November 12, 2003, from http://www.humanfactors.com/training/Webcasts.asp.

Rudd, J., Stern, K. & Isensee, S. (1996). Low vs. high- fidelity prototyping debate. *interactions, january*, 77 – 85.

Russo, P. & Boor, S. (1993). How fluent is your interface? designing for international users. *Proceedings of the SIGCHI conference on human factors in computing systems, Netherlands*, 342 – 347. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Salomon, G. (2000). A case study in interface design: the CHI '89 information kiosk. *Readings in human-computer interaction, second edition*, 25- 34.

Savage, P. (1996). User interface evaluation in an iterative design process: a comparison of three techniques. *Conference companion on human factors in computing systems: common ground, Canada*, 307 - 308. Paper retrieved August 12, 2003, from http://portal.acm.org/.

Sawyer, P., Flanders, A. & Wixon, D. (1996). Making a difference – The impact of inspections. *Proceedings of the SIGCHI conference on human factors in computing systems: common ground, Canada*, 376 – 382. Paper retrieved July 12, 2003, from http://www.acm.org/.

Scanlon, T. (1999). Usability labs: our take. Paper retrieved August 11, 2003, from http://www.uie.com/articles/usability_labs/.

Schaffer, E. (2001). The institutionalisation of usability. Paper retrieved August 20, 2003, from http://www.humanfactors.com/training/Webcasts.asp.

Schneider, K. (1996). Prototypes as assets, not toys, why and how to extract knowledge from prototypes. *Proceedings of the 18th international conference on software engineering, Germany*, 522 – 531. Paper retrieved August 11, 2003, from http://portal.acm.org/citation.cfm?id=227840&jmp=cit&coll=portal&dl=ACM&CFID=14259011&CFTOKEN=85861331#CIT.

Schonberg, E., Cofini, T., Hoch, R., Podlaseck, M. & Spraragen, S.L. (2000). Measuring success. *Communication of the ACM, 43*, 53-57.

Schroeder, W. (2003). Usability testing: learning from the work of others. Paper retrieved July 22, 2003, from http://www.uiconf.com/8/articles/learning_from_others.html.

Sefelin, R., Tscheligi, M. & Giller. (2003). Paper prototyping – what is it good for? a comparison of paper- and computer-based low-fidelity prototyping. *CHI '03 extended abstracts on human factors in computing systems table, USA*, 778 – 779. Abstract retrieved July 22, 2003, from http://portal.acm.org/.

Sears, A & Hess, P.J. (1998). The effect of task description detail on evaluator performance with cognitive walkthroughs. *CHI 98 conference summary on human factors in computing systems, United States,* 259 – 260. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Shackel, B. (1971). Human factors in the P.L.A. meat handling automation scheme. A case study and some conclusions. *Intl. J. Prod. Res. 9*, 95-121.

Shedroff, N. (2003). Experience design: new methodologies for creating successful user experiences. Paper retrieved March 12, 2003, from http://www.uiconf.com/8/fullday_shedroff.html.

Smart, K.L., Rice, J.C. & Wood, L.E. (2000). Meeting the needs of users: toward a semiotics of the Web. *Proceedings of 2000 Joint IEEE international and 18th annual conference on computer documentation,* 593 -605. Paper retrieved October 12, 2003, from http://www.ieee.org/.

Spinuzzi, C. (2002). A Scandinavian challenge, a Us response: methodological assumptions in Scandinavian and Us prototyping approaches. *Proceedings of the 20th annual international conference on computer documentation, Canada, 208 – 215.* Paper retrieved July 12, 2003, from http://www.portal.acm.org/.

Spool, J. M. (1992). In search of the ideal prototype. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 577 - 579. Paper retrieved October 12, 2003, from http://www.portal.acm.org/.

Spool, J.M. (2002a). 5 Things to know about users. Paper retrieved August 15, 2003, from www.uie.com.

Spool, J.M. (2002b). Evolution trumps usability guidelines. Paper retrieved August 15, 2003, from www.uie.com.

Spool, J.M. (2003a). Design patterns: an evolutionary step to managing complex sites. Paper retrieved August 12, 2003, from http://www.uiconf.com/8/articles/landay_vanduyne_article.html.

Spool, J.M. (2003b). Designing for the multiple personalities of users. Paper retrieved August 15, 2003, from www.uie.com.

Spool, J.M. (2003c). Field studies: the best tool to discover user needs. Paper retrieved August 12, 2003, from http://www.uiconf.com/8/articles/field_studies_article.html.

Spool, J.M. (2003d). Iterative Design – the power of cascading style sheets. Paper retrieved August 12, 2003, from http://www.uiconf.com/8/articles/iterative_design_css.html.

Statistics New Zealand. (2000). New Zealand official yearbook 2000. (ISSN 00780170). Bateman, D: Author.

Statistics New Zealand. (2002). New Zealand official yearbook 2000. (ISSN 00780170). Bateman, D: Author.

Stubblefield, W.A. (1998). Patterns of change in design metaphor a case study. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 73 – 80. Paper retrieved October 16, 2003, from http://portal.acm.org/.

Stray, C. (2000). Contextual prototyping of user interfaces. *Proceedings of the conference on designing interactive systems: processes, practices, methods, and techniques, United States,* 388 - 395 Paper retrieved October 12, 2003, from http://portal.acm.org/.

Sullivan, P. (1991). Multiple methods and the usability of interface prototypes: the complementarity of laboratory observation and focus groups. *Proceedings of the 9th annual international conference on systems documentation, United States*, 106 – 112. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Sun, H. (2001). Building a culturally-competent corporate Web site: an exploratory study of cultural markers in multilingual Web design. *Proceedings of the 19th annual international conference on computer documentation, USA*, 95 – 102. Paper retrieved October 12, 2003, from http://portal.acm.org/.

Sutcliffe, Alistair. (2000). On the effective use and reuse of HCI knowledge. *ACM Transactions on computer-human interaction, 7*, 197-221.

Thomas, C.G. & Fischer, G. (1997). Using agents to personalize the Web. *Proceedings of the 2nd international conference on intelligent user interfaces, United States,* 53 - 60. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Thomas, P. & Macredie, R.D. (2002). Introduction to the new usability. *ACM transactions on computer-human interaction, 7*, 69-73.

Tidwell, J. (1999). Common ground: A pattern language for human-computer interface design. Paper retrieved October 12, 2003, from http://www.mit.edu/~jtidwell/ui_patterns_eassy.html.

Torkzadeh, G. & Dhillon, G. (2002). Measuring factors that influence the success of the internet commerce. *Information systems research, 13,* 186-203.

Tractinsky, N. (1997). Aesthetics and apparent usability: empirically assessing cultural and methodology issues. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 115 - 122. Paper retrieved July 12, 2003, from http://www.acm.org/.

Usborne, N. (2003). Three instances where it pays to get the message right. Paper retrieved March 12, 2003, from http://www.uiconf.com/8/articles/usborne_article.html.

Vaidyanthan, J., Robbins, J.E. and Redmiles, D.F. (1999). Using html to create early prototypes. *CHI '99 extended abstracts on human factors in computing systems, Pennsylvania,* 232 – 233. Abstract retrieved March 12, 2003, from http://portal.acm.org/.

VanderMeer, D., Dutta, K. and Datta, A. (2000). Enabling scalable online personalization on the web. *Proceedings of the 2nd ACM conference on electronic commerce, United States,* 185 – 196. Paper retrieved July 12, 2003, from http://portal.acm.org/.

Vinson, N.G. (1999). Design guidelines for landmarks to support navigation in virtual environment. *Proceedings of the SIGCHI conference on human factors in computing systems, United States,* 278 – 285. Paper retrieved November 12, 2003, from http://portal.acm.org/.

Virizi, R. A., Sokolov, J.L., & Karis, D. (1996). Usability problem identification using both low- and high-fidelity prototypes. *Proceedings of the SIGCHI conference on human factors in computing systems: common ground, Canada,* 236 – 243. Paper retrieved July 15, 2003, from http://www.acm.org/.

Vora, P. R. (1998). Designing for web: a survey. *interactions, may + june,* 13-30.

Vredenburg, K., Mao, J., Smith, P.W. & Carey, T. (2002). A survey of user-centred design practice. *ACM,* 471-478.

Wasserman, A.S. (1989). Redesigning Xerox: a design strategy based on operability. In Klemmer, E.T. (ed.), *Ergonomics: harness the power of human factors in your business*, Ablex, Norwood, NJ.

Waterson, S., Landay, J.A. & Matthews, T., (2002). In the lab and out in the wild: remote Web usability testing for mobile devices. *CHI '02 extended abstracts on human factors in computing systems, USA*, 796 – 797. Abstracts retrieved October 12, 2003, http://portal.acm.org/.

Wharton, C., Bradford, J. & Franzke, M. (1992). Applying cognitive walkthroughs to more complex user interfaces: experiences, issues, and recommendations. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 381 – 388. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Wheeler, S. (2003). Use of research-based guidelines in development of Websites. *CHI '03 extended abstracts on human factors in computing, USA*, 696 – 697. Paper retrieved March 12, 2003, from http://portal.acm.org/.

Wilson, S. & Johnson, P. (1995). Empowering users in a task-based approach to design. *Proceedings of the conference on designing interactive systems: processes, practices, methods, & techniques, United States*, 25 - 31 Paper retrieved March 12, 2003, from http://portal.acm.org/.

Wilson, S., Bekker, M., Johnson, P. & Johnson, H. (1997). Helping and hindering user involvement – a tale of everyday design. *Proceedings of the SIGCHI conference on human factors in computing, United States*, 178 - 185. Paper retrieved August 12, 2003, from http://www.acm.org/.

Wixon, D. & Jones, S. (1991). Usability for fun and profit: a case study of the design of DEC rally version 2. Internal report, Digital Equipment Corporation.

Worden, A., Walker, N., Bharat, K. & Hudson, S. (1997). Making computers easier for older adults to use: Area cursors and sticky icons. *Proceedings of the SIGCHI conference on human factors in computing systems, United States*, 266 – 271. Paper retrieved March 12, 2003, from http://www.acm.org/.

Wright, P., Wooley-Mosser, D. & Wooley, B. (2001). Techniques & tools for using color in computer interface design. *Crossroads, 3*, 3-6. Paper retrieved March 12, 2003, from http://www.acm.org/.

Yee, W. (2002). The value of an expert review and 5-step review checklist. Paper retrieved March 12, 2003, from http://www.humanfactors.com/home/default.asp.

Yeo, A. (1996). World-wide CHI: Cultural user interface, a silver lining in cultural diversity. *SIGCHI bulletin, 28*, 1-8.